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318.

(Vol. XV.—January, 1886.)

ENGLISH AND AMERICAN RAILROADS COMPARED.

By EDWARD BATES DORSEY, M. Am. Soc. C. E.

READ AT THE ANNUAL CONVENTION, JUNE 24TH, 1885.

WITH ADDITIONS READ OCTOBER 7TH, 1885.

Perhaps the first thing that strikes an American engineer in railroad traveling in England * is the inconvenience of the English * passenger car. It should, however, be considered that this style of car suits the exclusive and retiring character of the English; and also that very long journeys, such as we are accustomed to make, are impossible in such a small island; moreover, the English do not travel nearly as much as we do, consequently the confinement in a small, locked-up

* EXPLANATORY NOTE.—In this paper, unless otherwise stated,
The words England or English will represent the United Kingdom, *i. e.*, England, Scotland, Wales and Ireland.
The pound sterling will be considered equal to five dollars American money.
The American ton contains 2 000 pounds.
The English ton contains 2 240 pounds.
The data used in this paper relating to the English railroads, were taken from the reports of the Board of Trade of the United Kingdom, or from the reports of the different railroad companies.
The data relating to the American railroads were taken from the reports of the Railroad Commissioners of the different States, Poor's Manual, and the reports of the different railroad companies.
For some unexplained reason, these different authorities do not always agree, consequently there may be apparent errors in this paper, when comparison is made with authority different from that from which it was originally taken.

compartment is not so much felt as it would be with us in our long journeys.

Much allowance must be made for the modern English railway engineer. Whatever faults he may have seen in the passenger cars, he has been powerless to make any important change, except at an unjustifiable cost. Stephenson and his colleagues mounted the old stage-coach body on car wheels, which became the type of the passenger cars; and coal wagons that were then in use in the collieries were put on the railroad, and became the type of freight cars; and before the conservative English character thought that they ought to be improved, and should be changed, the trunk lines had been built, adapted to this narrow and low type of rolling stock; to have made it wider and higher later would have required the removing and reconstruction of the masonry platforms, the raising and widening of bridges and tunnels—in fact, almost a reconstruction of the road. This will prevent the use of our high, wide and pleasant cars. It is not fair to blame the modern English engineer for continuing the use of this description of cars, which he cannot change at any justifiable expense.

Owing to the extent of the United States and the apparent isolation of our early railroads, or separation from each other (at the beginning we did not think as much of continuous connections, and not breaking bulk as we do now), our engineers were comparatively free to invent and adopt the best system according to their judgment, and later, when it became necessary to consolidate, the fittest has survived in our present system. Perhaps, owing to our bad roads, the American stage-coach did not come up to the American engineer's idea of luxurious or comfortable traveling; hence he kept on improving, and developed the Pullman hotel train as run between New York and St. Louis or Chicago, while on the good English roads this stage-coach came up to Stephenson's ideas of comfort and luxury.

Engineering, Locating, etc.

It is evident that the English engineer was not obliged to study economy so closely as the American in locating or constructing; judging by the work, the former has always had at his disposal abundance of time and money. The roads built by him could not have been built, as some of our American roads have been, at the rate of over five miles per day; or, as some were done, by laying the rails first and afterwards

building the road. The English engineer seems to have the idea that the railroad should be built as near a straight line and level as possible, and is willing to spend a much larger amount to approach this ideal perfection than the American engineer is. Consequently the English railroad is located much straighter, with easier curves and grades than the American location would have been over the same ground, but at greatly increased cost in money and time required for construction. Recently English engineers have introduced on their new roads curves and grades that would have been considered impracticable by Stephenson and his contemporaries.

In locating railroads in England, the engineer derives much assistance from the maps of the Ordnance Survey, which are so perfect that the route and approximate location can be determined before going on the ground in all the counties; while some counties are so perfectly contoured that a location and profile could be made without a survey, which would be correct enough for preliminary purposes.

Special Acts of Parliament must be obtained for every new road or branch. Before this can be applied for, much less obtained, there must be a very exact profile and map filed, showing everything within three hundred and thirty feet on each side of the proposed line. If Parliament should grant the application, only a very small deviation in grade or alignment is allowed from the plan and profile filed originally. These plans must be very correct. There is a story told that an application, strongly backed, was thrown out because a pig-sty had been omitted on the map filed. This application before Parliament is generally bitterly opposed by rival roads and interests, and the fight becomes long and expensive, each side employing prominent engineers and lawyers. It is said that in a recent case before Parliament, a prominent American engineer received 2 000 guineas ($10 500) for his testimony, which he gave in two and a half hours.

The following table shows the money that has been expended in promoting or opposing Bills before Parliament for eleven years, from 1871 to 1882 inclusive:

Municipal bodies	£1 289 757
Railway, Gas and Water Companies	4 664 874
Canal and Tramway Companies	416 043
Harbor and Dock Companies	360 574
Total	£6 731 248
At $5 per pound sterling	$33 656 240

About $3 000 000 annually, and this in dull times, after all the principal improvements had been completed or commenced. This amount is admitted to have been paid; probably much more was paid and charged to other accounts. Of this amount, £380 160 went in "House fees" paid to the House of Commons; say the fees paid to the House of Lords would be as much, there still remains £6 000 000 admitted to have been paid. This parliamentary business is very good for the English engineers; probably many of them make as much, or more, engineering in the Houses of Parliament as they do in the field. As a proof of the importance of this parliamentary engineering to the profession, nearly all the prominent engineers have their offices in Westminster, near the Houses of Parliament, and not in the city near the money center as with us.

The right of way is easily and quickly obtained after Parliament grants the right to build the road. In this grant is inserted what is called "Clauses Consolidation Acts." This provides that, in case the necessary land cannot be obtained on satisfactory terms by private purchase, application may be made to certain judges or magistrates named, who order the land in dispute to be appraised and the amount of this appraisement to be deposited in the Bank of England. As soon as proof is produced of this deposit, possession is given of the land. The money deposited is held, subject to the final settlement, by the Courts or otherwise, of the money to be paid for the land.

England offers no very serious engineering difficulties against railroad construction. But few lines attain the elevation of 900 feet above the sea; they have no high backbone divides to be crossed as we have. Probably the whole of England will compare in this respect with the United States, after excluding the strictly Prairie States. In round numbers, half of our railroads are constructed in a country offering no greater advantage than the United Kingdom for cheap construction.

English railroad men—it may be said foreigners generally—have a very erroneous idea about the physical geography of the United States. Nearly all believe that the American roads are built at a comparatively small cost, because the whole country is a level prairie, with nothing to do but to lay the ties and rails on the prairie sod. An old officer in the railroad department of the English Board of Trade was very much astonished when he was told that all our American roads are not built on the level prairie.

Cost of Land and Right of Way.

This is a large item in the cost of most English railroads. It is impossible to say how much, as no reliable data could be obtained. Some say it will average twenty thousand dollars per mile; this is undoubtedly too high. Cases have been mentioned where the price paid has been so large, that in our plain American language it would be called blackmail, but in the more polite English it is called land damages.

Construction.

This is generally much superior, stronger, more substantial, and a great deal more costly on the English roads than on ours. This difference is much greater on new roads. Our system of rushing the road through, and completing it afterwards at leisure times, is not practiced there. The Board of Trade impartially obliges every road, large or small, to be made at first up to its standard of perfection; consequently all English roads are well made at first, and kept up—all are first-class; if one falls below the standard, it is closed. This would be rather hard on some of our roads.

Wooden culverts or trestle-work are unknown in England. Brick viaducts are generally used where we would use trestle-work, or embankments in shallow depressions. Bridges are almost always built of brick, stone or iron; wooden ones are very rare.

Platforms and stations are generally built of masonry; some few are built of wood.

Embankments in England are generally made flatter, or with more slope than ours. Cuts are generally allowed to take their natural slope, though much more attention is paid in England to foot and side drains than with us.

The ballast in England is generally sandy gravel; there is no such road-bed as that on the Pennsylvania or Reading Railroad. The ties are sawn, generally over 10 inches wide, 6 inches thick and 9 feet long, and placed about 34 inches from center to center; at joints they are somewhat closer.

The rails generally used are the double-headed or reversible pattern, running up to 87 pounds per yard, with 52-pound chairs, on some of the railways running into London. The rails are secured into the chairs by wooden wedges or blocks. Some few flat or flanged bottom, called Vignolles or Colonial rails, are used, but they do not seem to be popular. Rails are generally 30 feet long, and made of Bessemer steel.

The English engineer is much favored by his mild winters. The frost is not sufficiently severe or penetrating to affect the stability of his road-bed or superstructure. The snows are comparatively very light, and would give no trouble, provided the railroad had the most simple ploughs in use on our Northern railroads for removing it.

In England there are no street, and very few ordinary road-crossings on a level, and these few are always provided with a gate and watchmen. The Board of Trade is very stringent in this respect, and we should imitate them by passing a law obliging all railroads in populous districts to do the same.

The ties are buried deep, apparently to make the road-bed as solid as possible, and on the end of the ties the ballast is heaped up to the level of the top of the rails. On some roads the chairs are bolted to the ties by screw-bolts, with the nuts under the tie.

As a sample of how costly the English railroads are built, the author contemplated building a new station, and got from the superintendent of the railroad the cost of building it, which was $11 000. There was no grading necessary, all that was required was simply two platforms with shed roofs, connected by an overhead bridge, 14½ feet headway, with two stairways leading from the platforms to the bridge.

Mr. Webb, the able Locomotive Superintendent of the London and North Western Railway, has recently introduced a steel sleeper that gives great satisfaction and promise. It is 9 feet long, weighing 124 pounds; near each end the sleeper is punched with six holes for the chairs. The chairs, weighing 14 pounds, are rolled from the waste ends of the steel rails, etc., then stamped into shape and holes punched. A steel lining plate, ¼ inch wide, is placed between the chair and sleeper. To prevent noise and working loose, brown paper, soaked in tar, is placed between the chair and plate, and plate and sleeper; then the whole is riveted together with steel rivets. This makes a very firm and solid road-bed, without any possibility of the rails spreading. The total weight of the sleeper, chairs and plates complete is 174 pounds, and at the present price of steel should not cost in the United States over 1½ cents per pound, or $2.61 for each sleeper. Mr. Webb says the total cost of labor on this sleeper is 5½d. = 11 cents. Total cost of sleeper at present prices in England, 8s. 3d., say $2.00. The rails are fastened, or rather secured, into the chairs by wooden wedges, as is usual on the English roads. The life of this sleeper is as yet an unknown quantity; rust is probably

the only thing that will destroy it. If the constant jar would not break or detach the asphalt coating used so successfully on water-pipes in California; or the coating of Dr. Angus Smith, used in many places satisfactorily on water-pipes; provided either of these coatings could be kept on intact, the life would be very long and there would be no doubt as to the economy of adopting it. The London and North Western Railway have put down five miles of these ties in order to test them thoroughly.

Some of these have been in use for five years, and as yet show no signs of weakness or decay. The coating still remains intact, notwithstanding the five years' service, with the frequent jar of heavy passing trains. Mr. Webb anticipates no trouble from rust. He has taken up water-pipes in good condition that have been buried for sixteen years, which were coated, previously to being buried, by the coating of Dr. Angus Smith. Mr. Webb's sleeper or tie will probably come into general use, as it possesses the maximum strength with the minimum weight and cost.

Locomotives.

For fast passenger trains, the engine generally has two large drivers about 7 feet 8 inches diameter; outside connected cylinders, horizontal; with bogie truck in front, and two trailing wheels. For slower passenger and freight trains generally four drivers; inside cylinders, outside connected; some with bogie trucks. Some freight engines have six drivers, outside connected, with inside inclined cylinders; all weight of engine on drivers. Many new engines are now built with four driving wheels; outside cylinders and connections; cylinders generally inclined.

The cab has finally been introduced upon most of the English engines, though there are still many without it. But it is not such luxurious quarters as the American engine-driver has; it is simply a small iron hood with small and fixed glass bull's-eyes, or windows that cannot be opened as with us, consequently they are very warm, and many of the engine-drivers object to the cab for that reason. It seems strange that no one has thought of our plan of having the windows large and on hinges, to be opened or closed at pleasure.

The bogie truck and outside connections, avoiding the crank axle, have had a hard and severe fight for favor on the English locomotive, but finally their merit has been recognized and many of the new locomotives are built on this system. Chairman Moon, at the half-yearly meeting of the London and North Western Railway Company, August,

1884, said: "Nothing has pleased me more lately than to see the old-fashioned crank axle done away with. We have had no accidents with it, but we are going to have something better than the crank axle."

It may not be amiss to state that on the Continent, engines with inside cylinders and connections have been almost entirely superseded by those with outside cylinders and connections.

Consumption of Fuel.

Many limited tests and experiments have been reported, but all, in my judgment, give much too high efficiency for the locomotive as a power producer, except on a limited experimental scale. Mr. William Strudley, M. Inst. C. E., Locomotive Superintendent of the London, Brighton and South Coast Railway, recently read a paper before the Institution of Civil Engineers. He stated that, in a locomotive of his design, one pound of coal will evaporate 12.95 pounds of water, and will convey one ton of train-load 13¾ miles at an average speed of 43.38 miles, the rate of consumption being 2.03 pounds of coal per horse-power per hour. The French engineers have reported recently 2.48 to 3.01 pounds of coal per horse-power per hour. In my judgment all these estimates are entirely too favorable; if not, the locomotive is not as expensive a fuel-burner as is generally thought.

Soft coal is universally used, except on the railroads in London, where a semi-anthracite is burned. This is used on account of giving off very little smoke, which would be very objectionable in the city.

Passenger Cars.

The extreme width of a passenger car that can be run on the average four feet eight and a half-inch gauge English railroad, is 8 feet 10 inches from extremity to extremity of eaves; this makes the cars too narrow to adopt the American construction of central aisle with double seats on each side. If it should be desired to adopt this system of central aisle, it would be necessary to reduce the length of the seats on one side from the length for two persons to that for one, as in some of our 3-feet gauge cars.

The Pullman cars that are run in England have been reduced in width from 10 feet to 8 feet 10 inches from eaves to eaves, and in height 13 inches. They are constructed on the same plan as generally with us, with a central aisle; the seats are too short to seat two persons

comfortably. They resemble very closely the Pullman cars made for our 3-feet gauge railroads.

For a short distance, and until the close confinement becomes tedious, nothing can be more comfortable and luxurious than the first-class English cars in pleasant weather. The absence of all toilet conveniences is a great inconvenience on long journeys.

On most railroads in England there is still no way of communicating between passenger, conductor and engine-driver, or from one car to another while the train is running. The London, Chatham and Dover road uses a bell-rope passing along the top of the floor, and the Great Eastern uses the bell-rope passing along the outside of the cars just under the eaves; this can easily be reached by opening the car window and reaching up.

The English passenger car is cold in cold weather, and hot and close in warm weather. If one is seated facing the engine he is in a gale, if seated on the front seat, is in a corner where no air can reach him. It does not run as smooth as the American; it is more difficult to read, and impossible to write in them.

On the London and North Western Railway, passenger trains with a seating capacity for 95 first-class, 60 second-class and 150 third-class—total, 305 passengers—and vans for their baggage, weigh 151.8 tons, or half a ton for each passenger.

Freight Cars and Trains.

The English freight car is about 15.5 feet long, with four wheels. About 90 per cent. of them are open cars, with sides and ends about 3 feet high. About one-fourth of each side at the middle of the car is on hinges, so as to open and facilitate unloading. About one-tenth of the cars are covered, corresponding to our box cars; these are generally covered with tarpaulins tied on; the roofs seem to be used more for safety or protection against robbery than for protection against rain. The open cars are always covered by a tarpaulin tied on, except when loaded with coal or other load that cannot be injured by the weather. These cars are coupled by heavy chains, and each car has about 1 foot of slack, consequently in starting the load comes very slowly upon the engine.

Only about 20 per cent. of the cars have brakes, and these are so placed that they cannot be manipulated while the train is in motion. In the rear of the train is a caboose with a brake; this, with those on the

engine and tender, is the only braking force that can be applied while the train is in motion. In long trains, or on steep grades, additional brake vans are attached, which make, on some roads, quite an important additional expense in the salary of the brakemen, and hauling up grade the dead weight of the brake vans, which, in order to be effective, are made very heavy.

These trains run generally about 25 miles an hour. The only hands employed on them are the engineer (called there the driver) and fireman on the engine, and the conductor in the tail caboose, with no means of communication with each other except by signs—the useful bell-rope not being used. One would think it would be impossible to avoid many serious accidents for the want of this communication between the conductor and the engine-driver, but they seem very fortunate in avoiding them. There is not much danger of a train breaking in two.

The average English freight car, or, as called in England, "goods wagon," carries a load of 8 tons, and weighs 5 tons, being 1.6 to 1; while with the American box freight car, carrying 50 000 pounds, and weighing 23 000 pounds, the proportion is 2.13 to 1.

Without any positive data before him, the author would judge that the first cost for the same amount of carrying tonnage is about the same in the two countries, but the cost of maintenance is probably in favor of the American car, as for the same carrying tonnage there are fewer pieces to be looked after and kept in order.

All freight cars are made of wood. Self-dumping or unloading cars are not in general use. Coal is generally unloaded by being shoveled into a wheelbarrow and wheeled to the pile; in some large yards it is unloaded by shovels, falling by gravity to the pile; in others, through a trap-door in the bottom of the car.

The English freight trains run at much greater speed than those of the United States, probably about 25 miles per hour. They do not average one-half of tons freight that the American trains do, while, owing to the superior construction of the roads, the comparatively straight lines and easy grades, the average train tonnage should be much larger —if not double.

The railway companies complain that the shippers require prompt delivery of goods. This could probably be done by the proper development of the express system, as practiced by the different railroads in the United States. This assures prompt delivery of fast freight, while

the slow freight comes at a much slower and profitable rate of speed to the railroad companies. By the reduction of the speed of the freight trains and increasing their load on the railroads of the United Kingdom, the cost of transportation could probably be largely reduced.

Passenger Fares.

The Midland Railway, which penetrates very thoroughly the Midland Counties of England and Southern Counties of Scotland, several years ago dispensed with the second-class carriages, and adopted the following rates:

First-class, per mile 1½d., and 5 per cent. Government tax added = 3⅛ cents. Third-class, per mile 1d. = 2 cents.

During the year 1883 the returns of the Midland Railway show that 94 per cent. of the total passenger traffic was third-class, which yielded 90 per cent. of the gross passenger receipts. Railways that have been brought into direct competition with it have been obliged to adopt the same rates, making their second-class fares about 2¾ cents per mile.

Where there is no competition, the following may be considered the average rates:

	Average per Mile.
First-class	4½ to 5 cents.
Second-class	3 to 3½ "
Third-class	2 "

The Great Northern Railway, one of the leading railroads of England, has recently decided to imitate the Midland, and only run first and third-class carriages on some of their lines. It is only a matter of time when all other roads will do the same.

It is only a matter of time when railways will dispense with or modify the first-class travel so as to make it pay; it is safe to say that no road in England now makes any money from its first-class travel. As long as they continue to sell first-class tickets, they must provide first-class carriages, as it is impossible to say beforehand what the transient travel will be; the consequence is, nearly every train has a large excess of empty first-class carriages, in order to accommodate all travel that may offer, as no one holding a first-class ticket would consent to take a seat in a second or third-class carriage. Moreover, the first-class passengers, even if the carriage were always filled, do not pay the road as well as the second or third-class. A compartment in a first-class carriage contains about 48 square feet, measured from

the outside of the car to the center of the dividing partition, and will seat eight persons. This gives 6 square feet to each person, which, at the price charged by the Midland Railway per mile, makes 6 divided by $3\frac{1}{6}$, say half of 1 cent per mile for each square foot of the floor of the car. The second and third-class apartments contain 40 and 35 square feet, and will carry 10 passengers. Taking the average second and third-class fares, this will give about two-thirds of 1 cent per mile for each square foot of floor surface. The dead load being about in the same proportion as the floor surface, it is clear that the first-class passenger is the most unproductive; moreover, the first cost of the first-class compartment and its maintenance is probably 20 per cent. greater than the second-class compartment, and 40 per cent. greater than the third-class.

All roads in the United Kingdom, except the Midland, virtually run six classes of carriages, viz., ordinary and smoking first-class, ordinary and smoking second-class, ordinary and smoking third-class. As it is impossible to fill all of these uniformly, there must necessarily be great loss of room and unnecessary haulage of dead weight.

The railroads running into London run what are called workmen's trains; by these trains working men or working women can go to and from their homes and work (say up to 15 miles) for 24 cents a week; this allows them to live in the suburbs where it is more healthy and rents are cheaper; weekly tickets are sold for the above amount, good for special designated trains in the morning and evening. Our roads should imitate the English roads in this respect.

Brakes.

In passenger trains there is generally one car in every three or four that have brakes. The vacuum brake, after a long and hard fight, has gained the victory, and is coming into general use on passenger cars. On very steep grades, when the brakes on the engine and the few brake cars would not be sufficient to hold the train in case of accident to the air brake, platform cars heavily loaded with cast-iron, with powerful brakes, are attached to each train going up or down, in order to hold the train in case of accident to the vacuum brakes; an expensive inheritance from the narrow stage-coach model, which could be avoided if the brakemen could go through a central aisle from car to car, and apply the brakes on each car as with us.

The freight trains have no brakes that can be used while the train is in motion, except those on the engine and caboose.

Our system of brakes could not be applied to freight trains there, as, owing to the lowness of the tunnels and bridges—another expensive inheritance from the old stage-coach model—brakemen could not walk over and along the top of the cars, and apply the brakes as with us. The only brake that could be adopted with safety would be one that could be worked from the engine or caboose, or buffer or compression brakes.

Block System.

It is astonishing to see the blind faith the English engine-driver places in his block signals. In dense fogs, where he cannot see one hundred feet ahead, or dark nights, when his vision is also very limited, for his head light is only an ordinary lantern, useless for illuminating the track and only used as a signal, the same as the tail light, or frequently where he has both the dark night and dense fog to run through, yet he runs at full speed and generally on schedule time, feeling sure that he is perfectly safe because his block signals have told him so, and they cannot make a mistake or lie.

The underground railroad in London and the London suburban railroads afford a fine illustration of this system. Notwithstanding the proverbial London fogs, these roads run their trains, probably several thousand daily, upon schedule time, and with a headway varying from three to three and a half minutes. And this is done without accident or delay.

If it had been in use, the accident two or three years ago in the Harlem Tunnel and also that at Spuyten Duyvil, in which Senator Wagner and others were killed, could not have occurred.

The English Government, through the Board of Trade, obliges all English railroads to adopt the block system, and run their trains by it, and we should follow their example. The officers of a railroad should be tried and convicted of premeditated murder in all cases of fatal accidents on their road that could have been avoided by the block system. It is no excuse for them to say it does not answer, for it does answer perfectly in England and other European countries; the officers controlling the roads ought to be made to feel that it is cheaper and safer to properly equip the road by using the block system, than to kill or maim passengers by not doing so.

Speed.

English freight trains run much faster than ours; probably averaging twenty-five miles an hour.

The passenger trains are generally faster, especially for short runs; but, owing to the small size of the island, there are no such trains as the New York and Chicago or the New York and St. Louis Express.

Table No. 1 gives the fastest trains on the principal roads of each country.

Baggage Checks.

These are still unknown in England. Some of the large railroads will receive baggage and deliver it at a given destination for a charge of sixpence for each package, provided the places at which it is received and delivered are both on their line, and are large places, such as London, Liverpool, Manchester, etc. There is nothing like our through check system over many distinct lines. This would be a very great convenience to those who have to travel in England, as the care of the baggage requires constant attention to see that some one else does not take it. It is placed in the baggage car without any distinctive mark of ownership, and subject to the call of the first claimant. Yet one seldom hears of its loss. This speaks well for the honesty of the English people.

The railroad managers and superintendents seem averse to making any change, even if it would promote the comfort of the traveler, and thereby induce increased travel. Some oppose the introduction of the check system for fear that the road would lose by being held responsible for lost baggage. In vain the author quoted to them the experience of the Pennsylvania Railroad, which handled in 1883 the baggage of over 23 000 000 passengers, amounting to nearly 2 000 000 pieces, and only had to pay in the whole year for lost and damaged baggage $1 262.03.

The English railroads could save a large expense by adopting the American baggage check system, as it would enable them to dispense with a large force of porters now employed in loading and unloading the baggage of passengers. Eighty per cent. of this labor would be done by the baggage express or transfer companies free of charge to the railroads.

TABLE No. 1.

Table showing the Fastest Speed made by Regular Trains on English and American Railroads between Terminal or Important Stations—Time-tables, June, 1885.

Names of Railroads.	From	To	Distance in Miles.	Time, Including Stoppages.		Average Miles per Hour, Including Stoppages.
				Hours.	Minutes.	
English Railroads.						
London and North Western	London	Liverpool	201.75	4	30	44.8
" "	"	Glasgow	406	10	30	40.6
" "	"	Edinburgh	401	9	55	40.4
" " (Wild Irishman)	"	Holyhead	264	6	5	43.4
Great Northern	"	Glasgow	444	10	20	43.0
" (Flying Scotchman)	"	York	188.25	3	55	48.1
"	"	Edinburgh	397	9	55	44.1
Great Western	"	Swansea	216	6	55	36.0
" (Flying Dutchman)	"	Bristol	118.5	2	36	45.6
London, Brighton and South Coast	"	Brighton	50	1	5	46.2
" " "	"	Dover	76.5	1	40	45.9
Midland	"	Nottingham	125	2	30	50.0
London, Chatham and Dover	"	Dover	77.75	1	48	43.2
American Railroads.						
New York, New Haven and Hartford	Boston	New York	234	6	0	39.0
New York and New England	"	"	227	6	0	37.8
Pennsylvania	Jersey City	Philadelphia	89	1	57	45.6
"	"	Pittsburgh	443	11	15	39.4
"	"	Chicago	911	24	45	36.8
New York Central and Hudson River	New York	Albany	143	3	15	44.0
" " "	"	Buffalo	441	10	45	41.0
" " "	"	Chicago	980	25	0	39.2
Central of New Jersey	Jersey City	Philadelphia	89	1	52	47.7
Baltimore and Ohio	Baltimore	Washington	40	0	45	53.0

Comfort in Traveling.

In the opinion of the writer this is not so great in England as with us. In addition to the trouble with the baggage, there is the discomfort of riding in winter in a cold car, obliging one to wrap up even for a short journey as if he was going to the Arctic Regions. No attempt at warming has been made, except by hot-water pans to the feet. Another serious inconvenience is the difficulty of getting information while *en route*, owing to the want of communication between the different compartments. It is impossible to ask questions of the train hands whilst in motion, and during the few limited stops at stations the employees are busy with their duties and endeavoring to answer the questions of many others in similar want of information. The writer once traveled from London to Gloucester, 114 miles, without being able to find out the destination of the car he was in.

Unless one is bound for a terminal station, he is obliged to be constantly on the alert, or he is apt to be carried beyond his destination. The train hands generally call out the names of the stations, but in so disguised and mispronounced a manner that they are unrecognizable. At stations there is often no one previous to the arrival of the train except the gatekeeper, who is generally a long distance off, up or down a flight of stairs, that can give any information about the trains.

The Board of Trade requires that a sign, with the name, must be placed at each station; but as station advertising is carried to a great extent throughout England, it is very difficult to recognise the station sign from the hundreds of advertisements, equally conspicuous, of "Pears' Soap," "Lorne Whiskey," "Coleman's Mustard," etc., surrounding the name of the station.

Ton and Passenger Mileage.

No return of these all-important items for comparison is made in England. The author, after careful inquiry and investigation, decided that the average freight charge on all freight moved in the United Kingdom was about 1¼ pence, or 2.5 cents per mile per ton; but, in order to be conservative, he has taken the average charge at 1 penny, or 2 cents per ton per mile.

In order to get the ton mileage, the receipts from freight, as reported by the companies, in pounds sterling has been multiplied by 240.

The author thinks, as do most of the persons with whom he has con-

sulted, that the average freight charge of $0.02 or 1 penny per mile per ton is too low by at least one-fourth; $0.025 or 1¼ pence would be nearer the correct amount. This more than makes up the difference between the English ton of 2 240 pounds and the American ton of 2 000 pounds. The English tonnage returns are all given in tons of 2 240 pounds, while the American returns are all in tons of 2 000 pounds.

Mr. J. S. Jeans, the able Secretary of the Iron and Steel Institute of England, who is very justly regarded as one of the most able statisticians of Great Britain, estimates that the average freight charge per mile on minerals is $0.015 or .75 pence per ton per mile. This would make the preceding average charge on all classes of freight of $0.02 or 1 penny per mile much too small.

The passenger mileage has been obtained by dividing the reported total receipts from ordinary passengers by the total number transported. This gives the average amount received from each passenger. Divide this by $0.0233*, gives the average mileage traveled by each passenger. Multiplying this by the number transported, gives the total mileage of ordinary passengers. In order to save labor and time, many of the following calculations for passenger mileage were made by multiplying the total reported receipts in pounds sterling from ordinary passengers by 206, the estimated average number of miles that can be traveled for each pound paid.

The mileage of the holders of season tickets has been ascertained by comparing the schedule lists of prices for season tickets as issued by the different railroads leading into London, with the distances; the average price is found to be about $0.009 or .45 pence per mile—say, $0.008 or .4 pence. This makes 600 miles as the average mileage traveled for each pound sterling reported as received from the sale of season tickets. Multiplying this reported amount by 600, gives the total mileage traveled by the holders of season tickets. Adding this to the total mileage of the ordinary passengers, gives the total mileage of all passengers.

It is very unfortunate for comparison that the English railroads do not report the passenger or ton mileage. The preceding figures have been adopted after careful inquiry and examination, and can be considered approximatively reliable until changed by official data from the companies.

*One and one-sixth pence being the estimated charge per passenger per mile on all the English railroads, first, second and third-class included, exclusive of season tickets.

The passenger and ton mileage for the American railroads have been taken from the official reports of the companies or from the reports of the Railroad Commissioners of the different States, and are reliable.

ACCIDENTS.

TABLE No. 2.

Passengers Killed and Injured from causes beyond their own control on all the Railroads of the United Kingdom, and those of the States of New York and Massachusetts in 1884.

	Total Length of Line Operated.	Total Mileage.			Killed.	Injured.
		Train.	Passenger.	Ton.		
United Kingdom	18 864	272 803 220	6 042 659 990	9 040 942 080	31	864
New York	7 298	85 918 677	1 729 653 620	9 322 518 571	10	124
Massachusetts	2 852	32 304 333	1 007 136 376	1 229 368 472	2	42
In 1 000 000 000 passengers transported 1 mile	United Kingdom				5.15	143
	New York				5.78	70
	Massachusetts				2.00	42
In 1 000 000 000 tons transported 1 mile	United Kingdom				3.44	96
	New York				1.11	14
	Massachusetts				1.63	34
					Miles.	
The average number of miles a passenger can travel without being killed	United Kingdom				194 892 255	
	New York				172 965 362	
	Massachusetts				503 568 188	
The average number of miles a passenger can travel without being injured	United Kingdom				6 992 662	
	New York				13 940 754	
	Massachusetts				23 955 630	

This table shows the comparative magnitude of the American railroad system. One single State has over 40 per cent. of the miles of railroad that the United Kingdom has, and transports more freight and nearly 30 per cent. of as many passengers.

The Board of Trade of England publish annually very complete returns of accidents on all their railroads. Unfortunately there are no such returns available for all the American roads.

The Railroad Commissioners of Massachusetts and New York make very complete returns for their States, which can be taken as a fair sample of the old and completed roads of the United States. The new

roads of the West will show a much higher percentage of accidents, owing to being open to traffic generally during construction—and being generally not so well built.

Table No. 2 was constructed from the preceding data, and the reports of the English Board of Trade, and of the Railroad Commissioners of New York and Massachusetts.

Cost of Railroads.

A casual observation shows that the English railroads cost much more than the American in their construction. It is evident that the English engineer always had in view that there was behind him plenty of money, and abundance of time to spend it in. Apparently there was no necessity for studying an economical alignment—heavy cuts and fillings or long bridges and tunnels, did not appear to frighten him at all; his ideal line was a straight line and dead level, and he kept as near this as circumstances would permit. This expensive construction, with apparently straight lines and easy grades, good road-bed, permanent brick buildings, and brick, stone or iron bridges, should make the annual expenses much lighter than on our roads, where perishable materials, for economical reasons, enter so largely into our buildings, bridges, etc., requiring frequent renewals.

The question naturally arises: Do the working results compensate for this great additional cost of the English over our railroads? In other words, "Does it pay?" To ascertain this, we must analyze the working expenses of each system; this is not an easy undertaking, as the published reports of the two countries do not correspond in form or outline. Unfortunately, the returns of the English railroads made to the Board of Trade, and the annual reports of the different companies, are not as thorough as one would wish for comparison. They do not give the quantity or cost of coal consumed, or separate the cost of freight or passenger traffic, or give the total or average ton and passenger mileage.

In order that you may investigate for yourselves, the problem whether it pays or not to spend so much money in constructing railroads, the Tables from No. 3 to No. 17 have been made, showing the operating expenses of all the railroads in the aggregate, and also of a few of the principal roads of each country. The principal, if not the only, advantage of expensive over cheap construction, is to reduce the operating expenses; to ascertain to what extent this has been done, in the

following accounts of the operating expenses all items of expense that are in any way affected by good or bad construction, have been added together, and the percentage calculated to the whole operating expenses. This percentage will naturally be larger in cheaply constructed roads with sharp curves and steep grades, and built with perishable materials, than in the expensively built roads in which money has been freely spent to reduce curves and grades, and in the use of more durable materials.

Mr. Jeans, the able statistician of England, makes this percentage 59.66 for all the American railroads. This has been taken by the author as the average standard of all the railroads in the United States; to this standard the English roads have been compared. The percentage of the individual American roads has been worked out from data contained in their annual reports, or from the reports of the Railroad Commissioners of the different States.

TABLE No. 3.

Comparative Proportion of Different Items of Operating Expenses, that are or are not Affected by Good or Bad Construction, on the Aggregate Railroads of the United Kingdom and United States for the year 1880.

1880.	United Kingdom.		United States.	
	Expenses that are Affected by good or bad Construction.	Expenses that are not Affected by Good or Bad Construction.	Expenses that are Affected by Good or Bad Construction.	Expenses that are not Affected by Good or Bad Construction.
Maintenance of Way	$17.70	.....	$25.31	
Locomotive Charges	24.40	.....	24.96	
Repairs of Carriages	8.40	.....	9.39	
Traffic Charges	.....	$30.00	.....	$25.31
Rates and Taxes	.....	5.00	.....	4.77
Government Duty	.....	2.40	.....	
Compensation—Passengers	.....	.70	.....	.39
Do. Goods	.....	.60	.....	.59
Legal and Parliamentary Expenses	.....	.90	.....	.70
Miscellaneous Expenses	.....	9.90	.....	8.58
Totals	$50.50	$49.50	$59.66	$40.34

This, and the two following tables, have been taken from a report recently made by Mr. J. S. Jeans, Secretary of the Iron and Steel Institute of Great Britain. Mr. Jeans is justly regarded as very good authority, and one of the most capable statisticians in this branch in England.

TABLE No. 4.

Showing the Number of Persons Employed on the Railroads of the United Kingdom and the United States in 1880.

1880.	United Kingdom.	United States.
Engine-drivers and Firemen	27 441	67 231
Guards	12 064	12 419
Plate-layers (Track-layers)	26 156	122 489
Pointsmen, etc. (Switchmen)	7 406	
Laborers	42 212	
Other railway servants	120 437	216 818
Totals	235 716	418 957
Average employés per 1 000 miles of goods and passenger trains	0.89	1.08
Average employés per mile of line open	13.	4.8
Average employés per 1 000 tons of traffic	0.9	0.7
Average employés per 1 000 passengers carried	0.38	0.65
Average employés per £1 000 earned	2.7	0.28

TABLE No. 5.

Showing the Rolling Stock used on Railroads of United Kingdom and United States in 1880.

1880.	United Kingdom.	United States.
Locomotives	14 469	17 412
Passenger Carriages	32 304	12 330
Freight Cars	446 333	375 312
Other Vehicles	12 024	84 613
Totals	505 130	489 667
Average vehicle per mile open	2.6	0.24
Average vehicle per 1 000 tons freight carried	0.5	0.59
Average vehicle per 1 000 passengers carried	1.3	0.53
Average vehicle per $5 000 capital	1.5	2.3

In the following Tables of the English Railroads, their percentage has been subtracted from 59.66, the average percentage of the American roads. This difference in the percentage, multiplied into the whole operating expenses, shows the gross saving by being well constructed. This divided by the number of miles operated, shows the annual saving per mile by the superior English over the inferior American construction. This amount capitalized at six per cent., shows the amount that the engineer would have been justified in expending per mile in construction over the cost of the inferior American system.

TABLE No. 6.

Operating Expenses of all the Railroads of the United Kingdom.

Year ending December 31st, 1883. Length of all Roads Operated, 18 681 Miles. Gauge, 4′ 8½″. Total cost, $3 777 808 395. Average Cost per Mile, $202 227.	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Maintenance of way, works, etc.	$33 718 990	
Locomotive power, including stationary engines, etc.	46 506 335	
Repairs and renewals of passenger and freight cars	16 476 835	
Traffic expenses, freight and passenger	.....	$56 061 995
General charges	.....	8 118 705
Rates and taxes	.....	9 304 245
Government duty	.....	3 696 280
Compensation for personal injury	.....	1 235 160
Compensation for damage and loss of goods	.....	989 705
Legal and Parliamentary expenses	.....	1 865 925
Steamboat and harbor expenses	.....	6 624 780
Sundries	.....	2 269 410
Totals ($186 868 365)	$96 702 160	$90 166 205
Percentage	51.8	48.2
Percentage, average of all American railroads in 1880	59.7	
Percentage in favor of all the railroads of the United Kingdom	7.9	

Total saved by all the railroads of the United Kingdom, $186 868 365 × .079 =	$14 762 600
Average saving per mile, $14 762 600 ÷ 18 681 =	790
Annual cost of $790 capitalized at 6 per cent =	13 167

TABLE No. 7.

Operating Expenses of the Great Eastern Railway of England.

Year ending December 31st, 1883. Length of Line Operated, 1 049 Miles. Gauge, 4′ 8½″.	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Maintenance of way	$1 481 740	
Locomotive power (including stationary engines)	2 575 085	
Repairs and renewals of passenger and freight cars	764 335	
Traffic expenses—freight and passenger	.....	$2 953 350
General charges	.....	387 070
Rates and taxes	.....	489 975
Government duty	.....	256 010
Compensation for personal injury	.....	84 795
Compensation for damage and loss of goods	.....	55 210
Legal and Parliamentary expenses	.....	76 020
Sundries	.....	810
Totals (*$9 074 400)	$4 821 160	$4 253 240*
Percentage	53.0	47.0
Percentage, average of all American railroads	59.7	40.3
Percentage in favor of Great Eastern Railway	6.7	

Total saved by Great Eastern Railway on operating 1 049 miles of railroad $9 074 400 × .067 =	$607 985
Average saving per mile, $607 985 ÷ 1 049 =	580
Annual cost of $580 capitalized at 6 per cent. =	9 660

* The cost of operating the steamboats, etc. ($899 430), has been deducted as not properly belonging to the railroad service.

TABLE No. 8.

Operating Expenses of the Great Northern Railway of England.

Year ending December 31st, 1883. Length of Line Operated, 768 Miles. Gauge, 4' 8½".	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Maintenance of way, works, etc.	$1 616 115	
Locomotive power (including stationary engines)	2 637 645	
Repairs and renewals of passenger and freight cars	842 130	
Traffic expenses—Freight and passenger		$3 326 745
General charges		493 245
Rates and taxes		533 745
Government duty		168 530
Compensation for personal injury		149 290
Compensation for damage and loss of goods		70 320
Legal and Parliamentary expenses		58 765
Steamboat, canal and harbor expenses		58 900
Sundries		91 610
Totals ($10 047 040)	$5 095 890	$4 951 150
Percentage	50.7	49.3
Percentage, average of all American railroads	59.7	40.3
Percentage in favor of Great Northern Railway	9.0	....

Total saved by Great Northern Railway on operating 768 miles of road $10 047 040 × .09 =	$904 234
Average saving per mile, $904 234 — 768 =	1 177
Annual cost of $1 177 capitalized at 6 per cent. =	19 617

TABLE No. 9.

Operating Expenses of the Midland Railway of England.

Year ending December 31st, 1883. Length of Line Operated, 1 793 Miles. Gauge, 4' 8½".	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Maintenance of way, works, etc.	$3 276 645	
Locomotive power (including stationary engines)	5 342 330	
Repairs and renewals of passenger and freight cars	2 069 555	
Traffic expenses—Freight and passenger		$6 413 915
General charges		713 350
Rates and taxes		957 475
Government duty		264 810
Compensation for personal injury, etc.		27 530
Compensation for damage and loss of goods		115 485
Legal and Parliamentary expenses		87 205
Sundries		135 495
Steamboat and harbor expenses		9 590
Totals ($19 413 385)	$10 688 530	$8 724 855
Percentage	55.1	44.9
Percentage, average of all American roads	59.7	40.3
Percentage in favor of Midland Railway	4.6	....

Total saved by Midland Railway on operating 1 793 miles, $19 413 385 × .046 =	$893 016
Average saving per mile, $893 016 ÷ 1 793 =	647
Annual cost of $647 capitalized at 6 per cent =	10 777

TABLE No. 10.

Operating expenses of the London and North Western Railway of England.

Year ending December 31st, 1883. Length of Line Operated, 1 793 Miles. Gauge, 4′ 8½″.	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Maintenance of way, works, etc.	$4 751 885	
Locomotive power (including stationary engines)	6 148 560	
Repairs and renewals of passenger and freight cars	1 670 015	
Traffic expenses—Freight and passenger	.....	$9 787 585
General charges	.....	1 236 520
Rates and taxes	.....	1 178 800
Government duty	.....	629 040
Compensation for personal injury, etc.	.....	149 665
Compensation for damage and loss of goods	.....	191 140
Legal and Parliamentary expenses	.....	275 485
Sundries	.....	137 730
Totals (*$26 156 425)	$12 570 460	*$13 585 965
Percentage	48.0	52.0
Percentage, average of all American railroads in 1880	59.7	....
Percentage in favor of London and North Western Railway	11.7	....

Total saved by London and North Western Railway on operating 1 793 miles of railway, $26 904 425 × .117 =	$3 147 821
Average saving per mile, $3 147 821 ÷ 1 793 =	1 756
Annual cost of $1 756 capitalized at 6 per cent. =	29 267

TABLE No. 11.

Operating Expenses of the Great Western Railway of England.

Year ending December 31st, 1883. Length of Line Operated, 2 268 Miles. Gauge, 7′ and 4′ 8½″.	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Maintenance of way, works, etc.	$4 497 670	
Locomotive power, including stationary engines	4 822 400	
Repairs and renewals of passenger and freight cars	1 533 820	
Traffic expenses—Freight and passenger	.....	$5 361 685 *
General charges	.....	763 285
Rates and taxes	.....	949 255
Government duty	.....	599 095
Compensation for personal injury	.....	39 585
Compensation for damage and loss of goods	.....	153 680
Legal and Parliamentary expenses	.....	258 035
Sundries	.....	210
Totals († $18 978 720)	$10 853 890	†$8 124 830
Percentage	57.2	42.8
Percentage, average of all American roads	59.7	40.3
Percentage in favor of Great Western Railway	2.5	....

Total saved by Great Western Railway on operating 2 268 miles of railroad, $18 978 720 × .025 =	$474 468
Average saving per mile, $474 468 ÷ 2 268 =	209
Annual cost of $209 capitalized at 6 per cent =	3 483

* The cost of operating the steamboats, etc. ($748 030), has been deducted, as not properly belonging to the cost of operating the railroad.

† The cost of operating the steamboats, etc., $942 515, is not included, as not properly belonging to the cost of operating the railroad.

TABLE No. 12.

Operating Expenses of the Baltimore and Ohio Railroad.

Year ending September 30th, 1883. Length of Line Operated, 553 Miles. Gauge, 4′ 8½″.	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
General expenses		$200 733.89
Losses by accidents, etc	$56 609.68	
Repairs of railroad	796 575.85	
Repairs of water stations	13 039.13	
Repairs and construction of depots	186 663.06	
Repairs of bridges	58 574.31	
Repairs of telegraph line	76 781.20	
Repairs of stationary machinery	118 276.66	
Watching cuts		30 546.15
Watching tunnels		5 451.67
Watching bridges		18 736.58
Pumping water	28 217.28	
Repairs of locomotives	624 146.36	
Repairs of passenger cars	299 386.71	
Repairs of freight cars	709 028.67	
Cleaning engines and cars		92 415.36
Contingent expenses of the machinery department	7 186.12	
Fuel	319 143.36	
Preparing fuel and filling tenders	20 096.37	
Pay of tonnage engineers	228 365.55	
Pay of tonnage firemen	105 505.61	
Pay of passenger engineers	82 812.24	
Pay of passenger firemen	40 013.25	
Expenses of transportation, salaries of agents, telegraph operators, clerks, station expenses, etc		2 029 350.7
Totals ($6 147 665.80)	$3 770 431.41	$2 377 234.39
Percentage	61.3	38.7

TABLE No. 13.

Operating Expenses of Pennsylvania Railroad. No. 1, Pennsylvania Division.

Main Line and Branches—Pittsburgh to Philadelphia.

Year ending December 31st, 1883. Gauge, 4′ 9″. Length of Road Operated, 1313.5 Miles.		Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Conducting Transportation		.....	$6 078 110.47
Motive Power		$5 237 379.22	
Maintenance of Cars		2 741 772.51	
Maintenance of Way		3 660 491.47	
General Expenses		.....	603 659.89
Totals	$18 321 413.56	$11 639 643.20	$6 681 770.36
Percentage		63.5	36.5

OPERATIONS.

Receipts from Freights	$24 778 190.15
Receipts from Passengers	5 989 625.35
Receipts from other Sources	1 249 997.79
Total Receipts from all Earnings	$32 017 813.29
Net Earnings from Operating	13 696 399.73
Total Mileage in this Division	1 313.53
Percentage of Operating Expenses to Earnings	57.22
Tonnage Moved	21 674 160
Tonnage Mileage	2 996 892 567
Average Ton Mileage	138.5
Average Earnings per Ton per Mile	$ .00819
Average Cost per Ton per Mile	.00477
Average Profit per Ton per Mile	.00342
Total Passengers Transported	10 697 474
Total Passenger Mileage	244 710 876
Average Passenger Mileage	22 $\frac{7}{10}$ Miles.
Average Earnings from each Passenger per Mile	$ .02448
Average Cost of Transporting each Passenger 1 Mile	.01640
Average Profit per Passenger per Mile	.00808

TABLE No. 14.

Operating Expenses of Pennsylvania Railroad. No. 3, Philadelphia and Erie Railroad Division.

Year ending December 31st, 1883. Gauge, 4' 9". Length of Road Operated, 287.5 Miles.	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Conducting Transportation	.....	$890 418.09
Motive Power	$762 468.99	
Maintenance of Cars	341 361.92	
Maintenance of Way	626 574.62	
Totals ($2 620 823.62)	$1 730 405.53	$890 418.09
Percentage	66.0	34.0

OPERATIONS.

Receipts from Freight	$3 352 417.79
Receipts from Passengers	667 742.66
Receipts from other Sources	88 682.71
Total Receipts from all Earnings	$4 108 843.16
Net Earnings from Operating	1 488 019.54
Percentage Operating Expenses to Earnings	63.8
Total Mileage in this Division	287.56
Tonnage Moved	5 154 935
Tonnage Mileage	520 249 716
Average Ton Mileage	100.9
Average Earnings per Ton per Mile	$ .00624
Average Cost per Ton per Mile	.00416
Average Profit per Ton per Mile	.00218
Total Passengers Transported	1 045 054
Total Passenger Mileage	21 908 174
Average Passenger Mileage	21 Miles.
Average Earnings from each Passenger per Mile	$ .03048
Average Cost of Transporting Each Passenger 1 Mile	.02075
Average Profit per Passenger per Mile	.00973

TABLE No. 15.

Operating Expenses of Pennsylvania Railroad. No. 2, New Jersey Division.

Year ending December 31st, 1883. Gauge, 4' 9". Length of Road Operated, 435 Miles.	Expenses that are affected by Good or Bad Construction.	Expenses that are not affected by Good or Bad Construction.
Conducting Transportation	.....	$5 433 260.35
Motive Power	$2 618 034.64	
Maintenance of Cars	622 251.12	
Maintenance of Way	1 736 301.22	
General Expenses	.....	103 491.37
Canal Expenses	.....	291 574.56
Totals—Exclusive of Canal Expenses..($10 804 913.26)	$4 976 586.98	$5 828 326.28
Percentage—Excluding Canal Expenses	46.0	54.

OPERATIONS.

Receipts from Freight	$8 269 943.20
Receipts from Passengers	5 542 247.22
Receipts from other Sources	1 144 405.23
Total Receipts from all Earnings	$14 956 595.65
Net Earnings from Operating	4 151 682.39
Total Mileage in this Division	435.07
Percentage of Operating Expenses to Earnings	72.95
Tonnage Moved	8 855 567
Tonnage Mileage	542 827 918
Average Ton Mileage	61.3
Average Earnings per Ton per Mile	$ .01471
Average Cost per Ton per Mile	.01167
Average Profit per Ton per Mile	.00304
Total Passengers Transported	11 339 330
Total Passenger Mileage	238 551 431
Average Passenger Mileage	21 Miles.
Average Earnings from each Passenger per Mile	$ .02074
Average Cost of Transporting each Passenger 1 Mile	.01571
Average Profit per Passenger per Mile	.00503

Few American engineers have the opportunity of seeing the English railroad reports. Tables 18, 19, 20 and 21 are exact reprints of all of that part of the semi-annual reports of the London and North Western Railway that relate to traffic for the years 1882, 1883 and 1884.

These will also enable those who are desirous, to make their own analysis of the data, as the author has done.

TABLE No. 16.

RAILROADS OF THE UNITED KINGDOM AND OF THE UNITED STATES COMPARED—1883.

LENGTH OF LINES OPERATED.	UNITED KINGDOM.		UNITED STATES.		REMARKS.
	Total.	Per Mile Operated.	Total.	Per Mile Operated.	
Single Track, miles	8 576				
Double or more Tracks	10 105				
Total miles of Line operated	18 681	.....	110 414	.....	About 23 per cent. of the total of the American roads is double track.
CAPITAL.					
Shares and Stock	$2 944 990 635	$157 646	$3 708 060 583	$30 759	The English roads subscribed £29-359 633 to other lines of railroads—this has been deducted, otherwise it would appear charged twice.
Loan and Debenture Stock	832 817 760	44 581	.....	.....	
Bonds	.....	.....	3 455 040 383	28 650	
Floating Debts	.....	.....	332 370 345	.....	
Total	$3 777 808 395	$202 227	$7 495 471 311	$62 176	
TRAIN SERVICE.					
Total mileage of Passenger Trains, miles	138 176 940	.....	193 960 013	.....	Including New York Elevated.
Total mileage of Freight Trains, including coal, miles	127 983 253	.....	350 108 255		
Total mileage of Mixed Trains, miles	2 737 043	.....			
Total Train mileage, miles	268 897 236	.....	544 068 268		
FREIGHT TRAFFIC.					
Minerals moved (coal, etc.), tons	189 485 612				
General merchandise moved "	76 897 356				
Total tons of freight moved, tons	266 382 968	.....	400 453 439	3 627	
Total ton mileage	9 288 316 560	.....	44 064 923 445		
Average Train Load in tons	71	.....	126		
Freight receipts from Minerals (coal, etc.)	$81 277 105	.....	.....	.....	These items for United Kingdom are taken from Board of Trade Reports for 1883. In the original they do not add up correctly.
" Merchandise	106 242 435	.....	.....	.....	
" Live Stock	5 862 230	.....	.....	.....	
Total Freight Receipts	$193 506 595	$10 359	$549 756 695	$5 000	
Average Receipts from each ton moved	$0.70	.....	$1.373		
Average Freight Charge per ton per mile	.....	$0.02	.....	$0.0124	This charge is estimated for the United Kingdom.
Average mileage of each ton moved, miles	35	.....	110	.....	For the United Kingdom this is based on the average charge per mile.

Total Freight Receipts	$193 506 595	$10 359	$549 756 695	$5 000	not add up correctly.
Average Receipts from each ton moved	$0.70	.....	$1.373		
Average Freight Charge per ton per mile	.....	$0.02	.....	$0.0124	This charge is estimated for the United Kingdom.
Average mileage of each ton moved, miles	35	.....	110	.....	For the United Kingdom this is based on the average charge per mile.
PASSENGER TRAFFIC.					
Total number First-class Passengers transported	36 387 877				
" " Second-class " "	66 096 784				
" " Third-class " "	581 233 476				
" " of holders of season tickets transported	632 050				
Total passengers of all classes transported	684 350 187	36 632	404 811 584	3 666	New York City Elevated Railways included.
Total passenger mileage	5 969 825 966	.....	8 817 684 503	.....	
Average mileage of each passenger transported, miles	7.2	.....	22 *	.....	For the United Kingdom these estimates of mileage, etc., are based upon the estimate of $0.0233, being the average passenger fare per mile.
Average number of passengers transported in each train per passenger train mile	.....	43	.....	45.5	
Receipts from First-class passengers	$18 350 265	$983			
" " Second-class "	16 648 720	891			
" " Third-class "	85 250 320	4 563			
" " Season Ticket "	8 462 955				
Total Receipts from passengers	$128 712 260	$6 890	$221 633 082	2 007	New York City Elevated Railways included.
Average Receipts from each passenger	$0.1881	.....	$0.5475	.....	do
Average mileage of each passenger, miles	.....	8	.....	22	
Average charge per mile for each passenger	.....	$0.0233	.....	0.0242	Estimated for United Kingdom.
EARNINGS.					

Average Receipts from each passenger	$0.1881	.....	$0.5475	.....	do
Average mileage of each passenger, miles	.....	8	.....	22	
Average charge per mile for each passenger	.....	$0.0233	.....	0.0242	Estimated for United Kingdom.
EARNINGS.					
Earnings from Freight Traffic	$193 506 595	$10 359	$549 756 695	$5 000	
" " Passenger Traffic	128 712 260	6 890	221 633 082	2 007	
Total Earnings from Freight and Passenger Traffic	$322 218 855	$17 249	$771 389 777	$7 007	
" " " all sources	355 311 330	19 020	823 772 924	7 461	
Percentage of Gross Earnings to Investment, Capital and Bonds	9.05	.....	10.99	.....	(This is on the inflated or watered
Percentage of Net Earnings to Investment, Capital and Bonds.	4.29	.....	4.49	.....	stock of the American railroads.
Operating Expenses of all Railroads operated	$186 842 810	$10 003	$486 861 040	4 410	
Percentage of Operating Expenses to Receipts	53.0	.....	59.0		
Total Net Earnings	$168 468 540	$9 019	$336 911 884	$3 051	
Percentage of Net Earnings to Gross Receipts	47.0	.....	41.0		
Passenger Earnings per Passenger Train mile	.....	$0.925	.....	$1.14	
Freight " " Freight " "	.....	1.50	.....	1.56	
ROLLING STOCK.					
Total Engines	14 469	.775	23 823	.216	
Total Passenger Cars	32 304	1.73	17 899	.162	
Total Baggage, Mail and Express Cars	2 024	.108	5 948	.054	
Total Freight Cars	446 333	23.90	748 661	6.78	

TABLE No. 17.

Showing the Percentage of the Annual Operating Expenses that is affected by Good or Bad Construction, of some of the Principal Railroads of the United Kingdom and United States.

Name of Railroad.	Country.	Miles of Line Operated.	Average Cost as shown by the Books. Per Mile.	Percentage.		Average Charges Per Mile.		Average Saving per Mile by good Construction over average American Railroads.	This Annual Saving capitalized at Six per cent.	Remarks.
				Affected.	Not Affected.	Ton.	Passenger			This last column shows how much could have been spent advantageously in addition over the average cost of American Railroads.
		Miles.	Dollars.	Per cent.	Per cent.	Dollars.	Dollars.	Dollars.	Dollars.	
All the Railroads, average of....	United Kingdom	18 681	202 227	51.8	48.2	0.02	0.0233	790	13 167	
London and South Western.....	England..	721	.....	49.7	50.3	.....	.....	1 142	19 033	
Great Eastern.....	"	1 049	.....	53.0	47.0	.....	.....	580	9 660	
Great Northern.....	"	768	.....	50.7	49.3	.....	.....	1 117	19 617	
Midland.....	"	1 381	.....	55.1	44.9	.....	.....	647	10 777	
London and North Western.....	"	1 793	.....	48.0	52.0	.....	.....	1 756	29 267	
Great Western.....	"	2 268	.....	57.2	42.8	.....	.....	209	3 483	
London, Chatham and Dover.....	"	160	744 970	51.5	48.5	.....	.....	1 496	24 933	
Caledonian.....	Scotland .	897	220 823	54.5	45.5	.....	.....	466	7 766	
North British.....	"	1 006	161 355	56.4	43.6	.....	.....	216	3 600	
Midland Great Western of.....	Ireland . .	425	69 250	62.0	38.0	.....	.....	.....	.....	149 miles double track. 276 " single " 136 " double "
Great Northern of.....	Ireland . .	503	70 000	64.0	36.0	.....	.....	.....	.....	367 " single " 195 " double "
Great Southern and Western of....	Ireland . .	478	80 000	60.0	40.0	.....	.....	.....	.....	283 " single "
All the Railroads, average of....	United States	110 414	62 176	59.7	40.3	0.0124	0.0242	.....	.....	59.7 was the average percentage of 1880, as per census. No reliable data for all the roads later.
Baltimore and Ohio, " Main Stem"	"	553	110 040	61.3	38.7	.....	.....	.....	.....	
Penn. Railroad—Penn. Division...	"	1 313	.....	63.5	36.5	0.00819	0.02448	.....	.....	
" Phil. and Erie " ...	"	288	.....	66.0	34.0	0.00624	0.03048	.....	.....	
" New Jersey " ...	"	435	.....	46.0	54.0	0.01471	0.02074	.....	.....	
" Av. of the three above Divisions.....	"	2 036	.....	58.0	42.0	.....	.....	.....	.....	
Phila., Wilmington and Baltimore.	"	413	109 000	55.0	45.0	.....	.....	.....	.....	
Boston and Albany, 1884.....	"	384	101 840	58.0	42.0	0.00665	0.0231	.....	.....	Coal very high on this line.
Delaware, Lackawan'a and W, 1884	"	400	.....	50.0	50.0	0.00902	0.0224	.....	.....	
L. Shore and Michigan Soth'n, "	"	1 339	.....	51.0	49.0	0.0068	0.02189	.....	.....	
N. Y. Cen. and Hudson R., "	"	993	.....	52.0	48.0	0.0083	0.0194	.....	.....	
New York, L. Erie and Western, "	"	1 029	.....	50.0	50.0	0.00719	0.02168	.....	.....	

TABLE No. 18.

Exact copy of the part of the Semi-Annual Report of the London and North Western Railway relating to Traffic and Operating Expenses for the Six Months ending June 30th, 1883.

DR. REVENUE ACCOUNT—HALF-YEAR ENDING JUNE 30TH, 1883. CR.

		June 30th, 1882.								June 30th, 1882.
Abstracts:	£ s. d		By Traffic, viz.:	Class.	No.	Amount. £ s. d.	£ s. d.	£ s. d.		
(A) To Maintenance of Way, Works and Stations	405 364 14 8	403 029	Passengers...	First	1 186 134	256 482 5 2				
(B) To Locomotive Power	599 742 2 6	556 960		Second	1 962 244	173 908 13 7				
(C) To Carriage and Wagon Repairs	158 966 12 1	163 981		Third	22 347 872	998 781 13 4				
To Mileage of Carriages and Wagons of other Companies	13 823 2 4	12 291		Season	19 578	72 703 17 9		1 501 876 9 10		
(D) To Traffic Expenses	952 194 1 2	928 600	Parcels, Horses, Carriages and Dogs					259 936 10 6		
(E) To General Charges	114 212 17 5	109 460	Mails					75 957 0 0		
To Law Charges	14 647 7 9	15 312							1 837 770 0 4	1 791 421
To Parliamentary Expenses	12 000 0 0	8 009								
To Compensation for Accidents and Losses: Passengers £10 036 4 3; Goods, etc. 17 260 12 0	27 296 16 3	34 087								
To Rates and Taxes	106 305 9 4	104 283								
To Government Duty	64 953 4 10	63 115	Merchandise			£1 966 366 6 10				
To North Union Railway—Proportion of Joint Expense	6 995 16 2	5 132	Less Expenses of Collection and Delivery of Goods by Agents			130 264 6 2		1 836 102 0 8		
To Birkenhead Railway—Proportion of Joint Expense	18 850 17 5	18 894								
To Shrewsbury and Hereford Railway—Proportion of Joint Expense	9 736 15 1	12 392								
To Shrewsbury and Wellington Railway—Proportion of Joint Expense	2 174 15 10	2 207								
To Shrewsbury and Welshpool Railway—Proportion of Joint Expense	1 253 13 1	2 828	Live Stock					79 465 8 6		
To Vale of Towy Railway—Proportion of Joint Expense	1 958 17 8	2 251	Minerals					1 168 120 2 8		
									3 083 687 11 10	3 039 680
									4 921 457 12 2	4 831 110
(F) To Steamboat Expenses	34 276 10 9	36 169								
To Depreciation and Insurance of Steamboats	10 000 0 0	10 000								
To Lancaster Canal Expenses	2 447 18 3	2 530								
To Huddersfield Canal Expenses	2 569 18 4	3 108	By Transfer Fees						724 2 6	742
										92 449
	2 559 771 10 11	2 494 629	By Rents of Land and Buildings					97 112 7 3		20 675
To Balance carried to Net Revenue Account	2 437 379 16 4	2 408 997	Less Repairs and Sundries					22 142 14 8	74 969 12 7	71 774
	£4 997 151 7 3	4 903 626							£4 997 151 7 3	4 903 626

TABLE No. 18.—*Continued.*

(A) MAINTENANCE OF WAY, ETC.		£ s. d.	30th June, 1882.
Salaries, Office Expenses and General Superintendence	£19 841 8 4		18 559
Maintenance and Renewal of Permanent Way, viz.:			
Wages	£138 979 0 7		130 290
Materials	48 715 7 10		55 337
Engines Ballasting	9 979 2 0		9 815
	197 673 10 5		195 442
Repairs of Approach Roads, Bridges, Signals, and other Works	57 515 16 7		57 699
Repairs of Stations and Buildings	35 229 4 3		31 991
		310 259 19 7	303 691
Rebuilding Stations		15 000 0 0	15 000
Repairs—Garston and Widnes Docks and Holyhead Harbor		6 017 3 3	3 953
" —St. Helens and Coalport Canals		2 825 19 7	2 899
Sundry Joint Lines and Stations		17 138 18 3	12 744
Signals, Sidings and Sundry Works		54 122 14 0	64 742
Miles Maintained: Double or more 1 310			
Single 374			
	1 684		
		£405 364 14 8	403 029

(B) LOCOMOTIVE POWER.		£ s. d.	30th June, 1882.
Salaries, Office Expenses and General Superintendence		19 137 11 0	18 441
Running Expenses:			
Wages connected with the Working of Locomotive Engines	£227 274 6 3		214 795
Coal and Coke	135 437 19 4		123 419
Water	4 996 3 5		4 837
Oil, Tallow and other Stores	22 679 14 1		22 047
		390 388 3 1	365 098
Repairs and Renewals of Engines, Tools, etc.:			
Wages	£89 705 3 8		88 311
Materials	93 487 2 6		77 911
		183 192 6 2	166 222
Special Expenditure		11 009 18 5	15 839
Stationary Engines, Liverpool Tunnels		4 404 19 7	2 225
		608 132 18 3	567 825
Cr., Mileage of Sundry Trains	£12 085 9 4		
Less—Cromford and High Peak Working	3 694 13 7		
		8 390 15 9	10 865
		£599 742 2 6	556 990

(C) REPAIRS AND RENEWALS OF CARRIAGES AND WAGONS.		£. s. d.	30th June, 1882.
Carriages—Salaries, Office Expenses and General Superintendence	£1 636 18 10		1 624
Wages	37 429 11 4		33 480
Materials	53 197 7 9		58 819
		92 263 17 11	93 923
Wagons—Salaries, Office Expenses and General Superintendence	£2 382 6 3		2 382
Wages	17 872 9 1		18 047
Materials	46 447 18 10		49 629
		66,702 14 2	70,058
		£158 966 12 1	163 981

TABLE No. 18.—*Continued.*

Stores.		30th June, 1882.
	£ s. d.	
Locomotive Department Stores	315 709 13 3	306 826
Locomotive Department Works in progress and Sundries	181 530 15 9	178 069
Carriage Department Stores	51 929 15 5	54 980
Carriage Department Sundries in process of manufacture	17 676 3 5	19 368
Wagon Department Stores	107 071 11 6	97 212
Wagon Department Sundries in process of manufacture	14 138 9 2	10 691
Permanent Way Stores	418 727 5 7	370 700
Engineering Stores	63 894 6 9	68 761
General Stores	27 224 9 11	29 387
Steamboat Stores	9 148 18 1	12 659
Telegraph Stores	14 261 9 5	10 793
	1 221 303 18 3	1 159 446
Engineering Stores, Joint Lines	36 300 14 8	31 595
Total	£1 257 604 12 11	1 191 041

(D) Traffic Expenses.			30th June, 1882.
		£ s. d.	
Salaries, Wages, etc., Coaching and Police Departments	£224 209 9 6		215 044
Fuel, Lighting, Water and General Stores	59 000 13 7		60 670
Clothing	13 475 7 8		11 848
Printing, Stationery and Tickets	15 408 4 10		16 385
Joint Station Expenses	20 646 16 9		20 787
Horses, Harness, Parcel Carts, Provender, etc.	11 836 9 1		11 389
		344 577 1 5	336 123
Salaries, Wages, etc., Merchandise Department	£419 710 8 10		411 042
Fuel, Lighting, Water, Grease and General Stores	28 480 6 5		26 017
Clothing	864 2 6		666
Printing, Stationery, etc.	8 749 17 1		9 354
Horses, Harness, Vans, Provender, etc.	96 802 7 7		99 322
Wagon Covers, Ropes, etc.	12 495 14 9		11 307
Joint Station Expenses	9 502 18 9		6 746
Agents' Commission	1 895 10 6		1 990
Hoists, Hydraulic Cranes, etc.	29 115 13 4		26 033
		607 616 19 9	592 477
		£952 194 1 2	928 600

(E) General Charges.			30th June, 1882.
		£ s. d.	
Direction		4 537 10 0	4 538
Auditors and Public Accountants		900 17 2	993
Salaries of Secretary, General Manager, Accountants and Clerks	£32 400 8 10		
Office Expenses Sundries	7 318 4 0		
		39 718 12 10	39 301
Advertising		2 039 17 6	1 670
Fire Insurance		6 905 6 8	6 905
Electric Telegraph Expenses		18 457 0 6	17 256
Railway Clearing House Expenses		15 289 14 10	14 446
Contribution to Superannuation Fund		6 294 13 2	6 279
Schools		1 162 6 8	943
Traveling Expenses, Directors, Managers, etc.		1 688 16 5	1 869
Provident and Insurance Societies and Pension Fund		9 252 19 8	8 047
Sundry Expenses, not classed		7 965 2 0	7 213
		£114 212 17 5	109 460

TABLE No. 18.—*Continued.*

(F) STEAMBOAT EXPENSES.		30th June, 1882.
	£ s. d.	
Salaries of Commanders, Wages of Crews, etc.....	19 142 5 11	19 310
Repairs, Ship Stores, etc.....	6 118 14 1	5 798
Coal and Engineers' Stores.....	10 014 11 5	10 937
Light and Harbor Dues.....	7 089 9 6	7 176
General Charges.....	1 959 9 10	2 804
	44 324 10 9	46 025
Less—Cost of Working Greenore Service.....	10 048 0 0	9 856
	£34 276 10 9	36 169

STEAMBOAT DEPRECIATION AND INSURANCE ACCOUNT.

	£ s. d.		£ s. d.
To Balance 31st Dec. last.....	1 180 10 10	By Amount set aside from Revenue this half-year.....	10 000 0 0
To Expended this half-year ..	176 13 7		
To Balance.....	8 642 15 7		
	£10 000 0 0		10 000 0 0

MILEAGE STATEMENT.

	Miles Authorized.	Miles Constructed.	Miles Constructing or to be Constructed.	Miles Worked by Engines.	30th June, 1882.
Lines owned by Company.....	1 546½	1 505	41½	1 499½	1 490
Lines partly owned	74½	73½	1	140½	140½
Lines Leased or Rented.....	146½	142½	3½	213½	213¼
Total	1 767½	1 721	46½	1 854	1 844½
Lines Worked.....	54	54	....	61½	51½
Foreign Lines Worked over	....	....	....	560½	569½
Total	1 821½	1 775	46½	2 476½	2 465½

STATEMENT OF TRAIN MILEAGE.

Passenger Trains.....	8 969 727	8 598 244
Goods and Mineral Trains.....	9 528 331	9 245 421
Total	18 498 058	17 843 665

TABLE No. 19.—*Continued.*

(A) MAINTENANCE OF WAY, ETC.			31st Dec., 1882.
		£ s. d.	
Salaries, Office Expenses and General Superintendence	£19 668 13 9		18 622
Maintenance and Renewal of Permanent Way, viz.:			
Wages	£138 169 17 2		132 483
Materials	133 968 14 8		135 557
Engines Ballasting	11 771 15 1		10 989
	283 910 6 11		279 029
Repairs of Approach Roads, Bridges, Signals and other Works	62 614 10 7		66 057
Repairs of Stations and Buildings	36 167 8 10		41 651
		402 361 0 1	405 359
Rebuilding Stations		20 000 0 0	20 000
Repairs—Garston and Widnes Docks and Holyhead Harbor		7 959 11 9	5 360
Repairs—St. Helens and Coalport Canals		3 326 9 1	2 638
Sundry Joint Lines and Stations		14 619 3 2	14 668
Signals, Sidings and Sundry Works		72 972 16 2	70 269
Miles Maintained:			
Double or more	1 313		
Single	374		
	1 687	£521 239 0 3	518 294

(B) LOCOMOTIVE POWER.			31st Dec., 1882.
		£ s. d.	
Salaries, Office Expenses and General Superintendence		18 961 10 7	19 204
Running Expenses:			
Wages connected with the Working of Locomotive Engines	£231 897 17 7		222 446
Coal and Coke	141 819 12 7		129 778
Water	4 728 2 8		4 563
Oil, Tallow and other Stores	27 292 15 2		22 725
		405 738 8 0	379 512
Repairs and Renewals of Engines, Tools, etc.:			
Wages	£90 774 9 6		94 064
Materials	93 885 4 8		84 624
		184 659 14 2	178 688
Special Expenditure		15 471 12 10	27 022
Stationary Engines, Liverpool Tunnels		3 653 3 2	2 167
Cr., Mileage of Sundry Trains	£14 288 6 10	628 484 8 9	606 593
Less—Cromford and High Peak Working	3 313 2 4	10 975 4 6	11 631
		£617 509 4 3	594 962

(C) REPAIRS AND RENEWALS OF CARRIAGES AND WAGONS.			31st Dec., 1882.
		£ s. d.	
Carriages—Salaries, Office Expenses and General Superintendence	£1 675 1 10		1 601
Wages	34 121 6 5		34 680
Materials	62 566 19 3		60 532
		98 363 7 6	96 813
Wagons—Salaries, Office Expenses and General Superintendence	£2 328 6 10		2 328
Wages	18 518 14 10		20 486
Materials	52 142 10 2		50 894
		72 989 11 10	73 708
		£171 352 19 4	170 521

TABLE No. 19.

Exact copy of the part of the Semi-Annual Report of the London and North Western Railway relating to Traffic and Operating Expenses for the six months ending December 31st, 1883.

DR. REVENUE ACCOUNT—HALF-YEAR ENDING DECEMBER 31ST, 1883. CR.

Abstracts:	£ s. d.	Dec. 31st, 1882.		Class.	No.	Amount.	£ s. d.	£ s. d.	Dec. 31st, 1882.
(A) To Maintenance of Way, Works and Stations	521 239 0 3	518 294	By Traffic, viz.: Passengers..	First.	1 246 005	303 003 2 9			
(B) To Locomotive Power	617 509 4 3	594 962		Second...	2 093 609	220 687 9 3			
(C) To Carriage and Wagon Repairs	171 352 19 4	170 522		Third....	25 335 955	1 233 774 15 4			
To Mileage of Carriages and Wagons of other Companies	11 431 5 3	11 361		Season...	17 260	57 969 5 0	1 815 434 12 4		
(D) To Traffic Expenses	964 726 9 2	969 175	Parcels, Horses, Carriages and Dogs				292 072 10 8		
(E) To General Charges	127 374 7 1	119 203	Mails				78 540 15 10		
To Law Charges	13 490 4 5	12 499						2 186 047 18 10	2 111 694
To Parliamentary Expenses	12 000 0 0	6 000							
To Compensation for Accidents and Losses: Passengers.....£19 397 10 0 Goods, etc..... 20 922 17 8	40 320 7 8	34 225	Merchandise.....			£1 998 720 14 11			
			Less Expenses of Collection and Delivery of Goods by Agents			124 962 10 1			
To Rates and Taxes	121 862 5 6	108 868					1 873 758 4 10		
To Government Duty	59 865 0 4	77 416							
To North Union Railway—Proportion of Joint Expense	7 738 1 3	7 035							
To Birkenhead Railway—Proportion of Joint Expense	18 834 0 0	16 997							
To Shrewsbury and Hereford Railway—Proportion of Joint Expense	10 666 8 10	11 927	Live Stock				122 473 10 7		
To Shrewsbury and Wellington Railway—Proportion of Joint Expense	2 553 8 0	1 864	Minerals				1 189 076 16 2		
								3 185 308 11 7	3 164 674
								5 371 356 10 5	5 276 368
To Shrewsbury and Welshpool Railway—Proportion of Joint Expense	1 344 18 6	3 351							
To Vale of Towy Railway—Proportion of Joint Expense	2 103 6 6	2 212							
(F) To Steamboat Expenses	37 188 12 5	35 129							
To Depreciation and Insurance of Steamboats	15 000 0 0	15 000							
To Lancaster Canal Expenses	2 267 7 11	2 492	By Transfer Fees					638 3 5	701
To Huddersfield Canal Expenses	3 715 5 10	2 809							
	2 762 582 12 6	2 721 341	By Rents of Land and Buildings				108 829 19 8		108 013
To Balance carried to Net Revenue Account	2 694 070 7 11	2 640 821	Less Repairs and Sundries				24 171 13 1	84 658 6 7	22 920 / 85 093
	£5 456 653 0 5	5 362 162						£5 456 653 0 5	5 362 162

TABLE No. 19.—*Continued.*

STORES.			31st Dec., 1882.
		£ s. d.	
Locomotive Department Stores		322 450 18 6	321 355
Do. Work in progress, and Sundries		191 302 9 0	198 768
Carriage Department Stores		54 448 13 6	56 251
Do. Sundries in process of manufacture		41 875 18 6	18 788
Wagon Department Stores		112 883 10 5	97 500
Do. Sundries in process of manufacture		16 143 7 5	14 601
Permanent Way Stores		441 260 2 4	426 865
Engineering Stores		35 526 2 3	38 544
General Stores		28 305 14 7	24 905
Steamboat Stores		10 302 0 9	9 280
Telegraph Stores		14 978 9 5	16 086
		1 269 477 6 8	1 222 943
Engineering Stores Joint Lines		36 455 15 4	29 171
Total		£1 305 933 2 0	1 252 114

(D) TRAFFIC EXPENSES.			31st Dec. 1882.
		£ s. d.	
Salaries, Wages, &c., Coaching and Police Departments	£236 307 18 7		230 377
Fuel, Lighting, Water and General Stores	57 194 10 2		59 032
Clothing	9 915 5 9		8 946
Printing, Stationery and Tickets	19 597 12 1		18 726
Joint Station Expenses	18 987 15 4		21 373
Horses, Harness, Parcel Carts, Provender, &c	10 983 17 10		14 087
		352 986 19 9	352 541
Salaries, Wages, &c., Merchandise Department	427 376 0 3		423 866
Fuel, Lighting, Water, Grease and General Stores	29 630 5 11		27 886
Clothing	712 2 4		841
Printing, Stationery, &c	9 198 15 5		8 842
Horses, Harness, Vans, Provender, &c	91 105 6 7		99 024
Wagon Covers, Ropes, &c	10 487 18 5		13 425
Joint Station Expenses	10 988 6 11		11 834
Agents' Commission	1 890 9 9		2 627
Hoists, Hydraulic Cranes, &c	30 350 3 10		28 289
		611 739 9 5	616 634
		£964 726 9 2	969 175

(E) GENERAL CHARGES.			31st Dec., 1882.
		£ s. d.	
Direction		4 537 10 0	4 538
Auditors and Public Accountants		897 12 1	964
Salaries of Secretary, General Manager, Accountants and Clerks	£32 522 10 2		
Office Expenses, Sundries	9 224 17 11		
		41 747 8 1	40 234
Advertising		3 629 17 3	3 029
Fire Insurance		13 810 13 4	13 811
Electric Telegraph Expenses		18 964 11 9	17 242
Railway Clearing House Expenses		16 909 15 6	15 911
Contribution to Superannuation Fund		6 312 1 1	6 113
Schools		1 303 4 6	872
Traveling Expenses, Directors, Managers, &c		1 544 8 5	1 792
Provident and Insurance Societies and Pension Funds		10 391 17 2	7 556
Sundry Expenses, not classed		7 325 7 11	7 141
		£127 374 7 1	119 203

TABLE No. 19.—*Continued.*

(F.) STEAMBOAT EXPENSES.		31st Dec., 1882.
	£ s. d.	
Salaries of Commanders, Wages of Crews, &c.	20 188 13 11	17 980
Repairs, Ship Stores, &c	6 888 3 3	5 292
Coal and Engineers' Stores	10 156 3 11	11 247
Light and Harbor Dues	7 289 10 4	8 260
General Charges	2 651 13 0	2 398
	47 174 4 5	45 177
Less—Cost of Working Greenore Service	9 985 12 0	10 048
	£37 188 12 5	35 129

STEAMBOAT DEPRECIATION AND INSURANCE ACCOUNT.

	£ s. d.		£ s. d.
To Expended this Half-year	610 0 0	By Balance 30th June last	8 642 15 7
To cost of new Cattle Steamer Holyhead, lost 30th October last	35 817 3 11	By Amount set aside from Revenue this Half-year	15 000 0 0
		By Balance	12 784 8 4
	£36 427 3 11		£36 427 3 11

MILEAGE STATEMENT.

	Miles Authorized.	Miles Constructed.	Miles Constructing or to be Constructed.	Miles Worked by Engines.	31st Dec., 1882.
Lines owned by Company	1 570½	1 524½	46¼	1 519	1 493
Lines partly owned	80½	79½	1	152	140¾
Lines Leased or Rented	146½	142¾	3¾	213¾	213¾
Total	1 797½	1 746½	51	1 884¾	1 847½
Lines Worked	30¾	30¾	..	33¾	51½
Foreign Lines Worked over	..	..	..	562¾	560¾
Total	1 828¼	1 777¼	51	2 481¼	2 459¾

STATEMENT OF TRAIN MILEAGE.

Passenger Trains	9 796 002	9 389 561
Goods and Mineral Trains	9 802 718	9 547 258
Total	19 598 720	18 936 819

TABLE No. 20.

Exact copy of the part of the Semi-Annual Report of the London and North Western Railway relating to Traffic and Operating Expenses for the six months ending June 30th, 1884.

DR. REVENUE ACCOUNT—HALF-YEAR ENDING JUNE 30TH, 1884. CR.

Abstracts:	£ s. d.	June 30th, 1883.
(A) To Maintenance of Way, Works and Stations	407 085 19 5	405 365
(B) To Locomotive Power	613 389 1 4	599 742
(C) To Carriage and Wagon Repairs	185 718 8 6	158 967
To Mileage of Carriages and Wagons of other companies	13 979 4 4	13 823
(D) To Traffic Expenses	941 888 6 10	952 194
(E) To General Charges	115 336 13 6	114 213
To Law Charges	13 789 8 5	14 647
To Parliamentary Expenses	11 500 0 0	12 000
To Compensation for Accidents and Losses: Passengers.. £11 504 0 8 Goods, etc.. 19 353 2 7	30 857 3 3	27 297
To Rates and Taxes	108 961 18 9	106 305
To Government Duty	23 752 10 4	64 953
To North Union Railway—Proportion of Joint Expenses	7 258 4 9	6 996
To Birkenhead Railway—Proportion of Joint Expenses	17 672 19 6	18 851
To Shrewsbury and Hereford Railway—Proportion of Joint Expenses	11 300 4 9	9 737
To Shrewsbury and Wellington Railway—Proportion of Joint Expenses	1 827 7 8	2 175
To Shrewsbury and Welshpool Railway—Proportion of Joint Expenses	2 263 13 1	1 254
To Vale of Towy Railway—Proportion of Joint Expenses	1 916 13 3	1 959
(F) To Steamboat Expenses	37 615 19 2	34 276
To Depreciation and Insurance of Steamboats	10 000 0 0	10 000
To Lancaster Canal Expenses	2 141 4 8	2 448
To Huddersfield Canal Expenses	2 908 14 9	2 569
	2 561 163 16 3	2 559 771
To Balance carried to Net Revenue Account	2 353 221 17 7	2 437 380
	£4 914 385 13 10	4 997 151

By Traffic, viz.:	Class.	No.	Amount. £ s. d.	£ s. d.	£ s. d.	June 30th, 1883.
Passengers..	First	1 139 500	241 533 15 7			
	Second	1 946 000	172 710 13 2			
	Third	22 841 751	1 007 949 19 8			
	Season	20 119	71 947 6 0			
				1 494 141 4 5		
Parcels, Horses, Carriages and Dogs				282 549 14 2		
Mails				80 288 18 7		
					1 856 979 17 2	1 837 770
Merchandise			£1 922 229 17 0			
Less Expenses of Collection and Delivery of Goods by Agents			118 691 15 10			
				1 803 538 1 2		
Live Stock				86 413 1 11		
Minerals				1 092 490 16 1		
					2 982 441 19 2	3 083 687
					4 839 421 16 4	4 921 457
By Transfer Fees					756 6 8	724
By Rents of Land and Buildings				98 143 17 0		97 112
Less Repairs and Sundries				23 936 6 2		22 142
					74 207 10 10	74 970
					£4 914 385 13 10	4 997 151

TABLE No. 20.—*Continued.*

(A) MAINTENANCE OF WAY, &c.			30th June, 1883.
		£ s. d.	
Salaries, Office Expenses and General Superintendence	£20 018 9 8		19 841
Maintenance and Renewal of Permanent Way, viz.:			
Wages	£136 112 18 2		138 979
Materials	48 402 7 1		48 716
Engines Ballasting	10 270 18 5		9 979
	194 786 3 8		197 674
Repairs of Approach Roads, Bridges, Signals and other Works	62 235 7 6		57 516
Repairs of Stations and Buildings	33 679 4 9		35 229
		310 719 5 7	310 260
Rebuilding Stations		15 000 0 0	15 000
Repairs—Garston and Widnes Docks and Holyhead Harbor		7 614 17 1	6 017
Do. St. Helens and Coalport Canals		3 380 16 8	2 826
Sundry Joint Lines and Stations		16 467 1 2	17 139
Signals, Sidings and Sundry Works		53 903 18 11	54 123
Miles Maintained: Double or more 1 321			
Single 370			
	1 691		
		£407 085 19 5	405 365

(B) LOCOMOTIVE POWER.			30th June, 1883.
		£ s. d.	
Salaries, Office Expenses and General Superintendence		19 985 6 8	19 138
Running Expenses:			
Wages connected with the Working of Locomotive Engines	£225 699 9 11		227 274
Coal and Coke	142 353 15 10		135 438
Water	4 237 5 3		4 996
Oil, Tallow and other Stores	24 071 15 0		22 680
		396 362 6 0	390 388
Repairs and Renewals of Engines, Tools, &c.:			
Wages	£88 079 3 2		89 705
Materials	105 272 5 3		93 487
		193 351 8 5	183 192
Special Expenditure		10 914 14 0	11 010
Stationary Engines, Liverpool Tunnels		3 537 13 6	4 405
		624 151 8 7	608 133
Cr., Mileage of Sundry Trains	£15 194 15 10		
Less—Cromford and High Peak Working	4 432 8 7		
		10 762 7 3	8 391
		£613 389 1 4	599 742

(C) REPAIRS AND RENEWALS OF CARRIAGES AND WAGONS.			30th June, 1883.
		£ s. d.	
Carriages—Salaries, Office Expenses and General Superintendence	£1 752 8 4		1 637
Wages	38 523 4 6		37 430
Materials	78 185 17 4		53 197
		118 461 10 2	92 264
Wagons—Salaries, Office Expenses and General Superintendence	£2 396 12 9		2 382
Wages	18 728 3 7		17 873
Materials	46 132 2 0		46 448
		67 256 18 4	66 703
		£185 718 8 6	158 967

TABLE No. 20.—*Continued.*

STORES.			30th June, 1883.
		£ s. d.	
Locomotive Department Stores		316 744 6 1	315 710
Do. Work in progress, and Sundries		186 327 4 7	181 531
Carriage Department Stores		58 834 17 7	51 921
Do. Sundries in process of manufacture		38 508 4 1	17 676
Wagon Department Stores		118 707 4 3	107 072
Do. Sundries in process of manufacture		20 649 16 6	14 138
Permanent Way Stores		458 299 13 6	418 727
Engineering Stores		68 887 3 11	63 894
General Stores		29 131 12 9	27 224
Steamboat Stores		14 404 4 8	9 149
Telegraph Stores		14 492 0 5	14 261
		1 324 986 8 4	1 221 303
Engineering Stores, Joint Lines		33 539 16 6	36 301
Total		£1 358 526 4 10	1 257 604

(D) TRAFFIC EXPENSES.			30th June, 1883.
		£ s. d.	
Salaries, Wages, &c., Coaching and Police Departments	£230 779 16 7		224 209
Fuel, Lighting, Water and General Stores	62 956 11 1		59 001
Clothing	12 547 0 9		13 475
Printing, Stationery and Tickets	14 865 3 8		15 408
Joint Station Expenses	18 689 16 7		20 647
Horses, Harness, Parcel Carts, Provender, &c	11 648 18 5		11 837
		351 487 7 1	344 577
Salaries, Wages, &c., Merchandise Department	416 285 8 7		419 710
Fuel, Lighting, Water, Grease and General Stores	28 853 19 5		28 480
Clothing	735 1 6		864
Printing, Stationery, &c	9 024 0 4		8 750
Horses, Harness, Vans, Provender, &c	82 721 0 4		96 802
Wagon Covers, Ropes, &c	10 144 19 6		12 496
Joint Station Expenses	10 834 13 11		9 503
Agents' Commission	1 964 11 8		1 896
Hoists, Hydraulic Cranes, &c	29 837 4 6		29 116
		590 400 19 9	607 617
		£941 888 6 10	952 194

(E) GENERAL CHARGES.			30th June, 1883.
		£ s. d.	
Direction		4 537 10 0	4 538
Auditors and Public Accountants		913 18 4	901
Salaries of Secretary, General Manager, Accountants and Clerks	£33 508 2 0		
Office Expenses, Sundries	7 455 9 0		
		40 963 11 0	39 718
Advertising		1 964 15 2	2 040
Fire Insurance		6 905 6 8	6 905
Electric Telegraph Expenses		18 176 2 10	18 457
Railway Clearing House Expenses		14 798 2 4	15 290
Contribution to Superannuation Fund		6 472 13 7	6 295
Schools		1 185 13 5	1 162
Traveling Expenses, Directors, Managers, &c		1 655 9 9	1 689
Provident and Insurance Societies and Pension Funds		11 662 14 11	9 253
Sundry Expenses, not classed		6 100 15 6	7 965
		£115 336 13 6	114 213

TABLE No. 20.—*Continued.*

(F) STEAMBOAT EXPENSES.	£ s. d.	30th June, 1883.
Salaries of Commanders, Wages of Crews, &c	20 203 12 4	19 142
Repairs, Ship Stores, &c	7 002 13 3	6 119
Coal and Engineers' Stores	10 784 15 3	10 015
Light and Harbor Dues	7 181 11 2	7 089
General Charges	2 363 7 2	1 960
	47 535 19 2	44 325
Less—Cost of Working Greenore Service	9 920 0 0	10 048
	£37 615 19 2	34 277

STEAMBOAT DEPRECIATION AND INSURANCE ACCOUNT.

	£ s. d.		£ s. d.
To Balance 31st Dec. last	12 784 8 4	By Amount set aside from Revenue this Half-year	10 000 0 0
To Expended this Half-year	438 16 9	By Balance	3 223 5 1
	£13 223 5 1		£13 223 5 1

MILEAGE STATEMENT.

	Miles Authorized.	Miles Constructed.	Miles Constructing or to be Constructed.	Miles Worked by Engines.	30th June, 1883.
Lines owned by Company	1 570½	1 528¾	41¾	1 523½	1 499½
Do. partly owned	80½	79½	1	152	140½
Do. Leased or Rented	146½	142½	3½	213½	213½
Total	1 797½	1 751	46½	1 889½	1 854
Lines Worked	30½	30½	....	33½	61½
Foreign Lines Worked over	....	....	....	562½	560½
Total	1 828½	1 781½	46½	2 485½	2 476½

STATEMENT OF TRAIN MILEAGE.

Passenger Trains	9 318 457	8 969 727
Goods and Mineral Trains	8 933 380	8 728 331
Total	18 251 837	17 698 058

TABLE No. 21.—*Continued.*

(A) MAINTENANCE OF WAY, &c.				31st Dec., 1883.
		£ s. d.		
Salaries, Office Expenses, and General Superintendence	£19 145 19 2			19 669
Maintenance and Renewal of Permanent Way, viz.:				
Wages	£136 848 19 3			138 169
Materials	135 880 11 9			133 969
Engines Ballasting	11 010 7 2			11 772
	283 739 18 2			283 910
Repairs of Approach Roads, Bridges, Signals, and other Works	70 029 13 1			62 615
Repairs of Stations and Buildings	40 745 10 2			36 167
		413 661 0 7		4[illegible] 2 381
Rebuilding Stations		20 000 0 0		20 000
Repairs—Garston and Widnes Docks and Holyhead Harbor		6 719 5 0		7 960
Do. St. Helens and Coalport Canals		3 758 12 7		3 306
Sundry Joint Lines and Stations		17 420 3 4		14 619
Signals, Sidings, and Sundry Works		46 658 8 5		72 973
Miles Maintained:				
Double or more	1 334			
Single	370			
	1 704	£508 217 9 11		521 239

(B) LOCOMOTIVE POWER.				31st Dec., 1883.
		£ s. d.		
Salaries, Office Expenses, and General Superintendence		19 421 7 6		18 962
Running Expenses:				
Wages connected with the Working of Locomotive Engines	£238 585 18 2			231 898
Coal and Coke	140 763 11 0			141 819
Water	5 581 11 8			4 728
Oil, Tallow, and other Stores	27 256 11 6			27 293
		412 187 12 4		405 738
Repairs and Renewals of Engines, Tools, &c.:				
Wages	£90 523 2 4			90 774
Materials	96 598 6 4			93 885
		187 121 8 8		184 659
Special Expenditure		15 479 5 1		15 472
Stationary Engines, Liverpool Tunnels		3 724 9 1		3 653
		637 934 2 8		628 484
Cr., Mileage of Sundry Trains	£16 947 12 10			
Less—Cromford and High Peak Working	2 914 16 5			
		14 032 16 5		10 925
		£623 901 6 3		617 509

(C) REPAIRS AND RENEWALS OF CARRIAGES AND WAGONS.				31st Dec., 1883.
		£ s. d.		
Carriages—Salaries, Office Expenses and General Superintendence	£1 695 2 1			1 675
Wages	38 096 3 3			34 121
Materials	72 543 19 2			62 567
		112 335 4 6		98 363
Wagons—Salaries, Office Expenses and General Superintendence	£2 353 8 0			2 328
Wages	22 743 10 2			18 519
Materials	46 621 4 8			52 143
		71 718 2 10		72 990
		£184 053 7 4		171 353

TABLE No. 21.

Exact copy of the part of the Semi-Annual Report of the London and North Western Railway relating to Traffic and Operating Expenses for the six months ending December 31st, 1884.

DR. REVENUE ACCOUNT—HALF-YEAR ENDING DECEMBER 31ST, 1884. CR.

Abstracts:	£ s. d.	Dec. 31st, 1883.
(A) To Maintenance of Way, Works and Stations	508 217 9 11	521 239
(B) To Locomotive Power	623 901 6 3	617 509
(C) To Carriage and Wagon Repairs	184 053 7 4	171 353
To Mileage of Carriages and Wagons of other Companies	10 774 2 7	11 431
(D) To Traffic Expenses	958 739 9 5	964 726
(E) To General Charges	126 791 18 10	127 374
To Law Charges	13 449 10 8	13 490
To Parliamentary Expenses	12 000 0 0	12 000
To Compensation for Accidents and Losses: Passengers. £14 527 12 0 Goods, etc... 22 386 2 4	36 913 14 4	40 321
To Rates and Taxes	128 003 2 11	121 862
To Government Duty	28 578 17 8	59 865
To North Union Railway—Proportion of Joint Expense	8 060 1 4	7 738
To Birkenhead Railway—Proportion of Joint Expense	17 213 2 1	18 834
To Shrewsbury and Hereford Railway—Proportion of Joint Expense	11 935 6 3	10 667
To Shrewsbury and Wellington Railway—Proportion of Joint Expense	3 602 13 10	2 554
To Shrewsbury and Welshpool Railway—Proportion of Joint Expense	2 107 0 0	1 345
To Vale of Towy Railway—Proportion of Joint Expense	2 320 6 3	2 103
(F) To Steamboat Expenses	37 897 10 6	37 189
To Depreciation and Insurance of Steamboats	15 000 0 0	15 000
To Lancaster Canal Expenses	2 056 0 1	2 268
To Huddersfield Canal Expenses	2 647 9 7	3 715
	2 734 262 9 10	2 762 583
To Balance carried to Net Revenue Account	2 677 152 19 11	2 694 070
	£5 411 415 9 9	5 456 653

	Class.	No.	Amount.	£ s. d.	£ s. d.	Dec. 31st, 1883.
By Traffic, viz.: Passengers..	First	1 180 832	289 514 8 2			
	Second	2 039 590	214 170 4 5			
	Third	25 788 360	1 273 754 3 4			
	Season	18 959	60 566 1 11			
				1 838 004 17 10		
Parcels, Horses, Carriages and Dogs				303 251 2 3		
Mails				83 182 13 6		
					2 224 438 13 7	2 1-6 048
Merchandise			£1 955 869 6 9			
Less Expenses of Collection and Delivery of Goods by Agents			120 076 19 6			
				1 835 792 7 3		
Live Stock				127 267 9 9		
Minerals				1 130 339 10 0		
					3 093 399 7 0	3 185 309
					5 317 838 0 7	5 371 357
By Transfer Fees					752 14 0	638
By Rents of Land and Buildings				116 879 13 4		108 830
Less Repairs and Sundries				24 054 18 2		24 172
					92 824 15 2	84 658
					£5 411 415 9 9	5 456 653

TABLE No. 21.—*Continued.*

STORES.			31st Dec., 1883.
		£ s. d	
Locomotive Department Stores		344 406 18 6	322 451
Do. Work in progress and Sundries		208 191 0 4	191 302
Carriage Department Stores		61 125 14 0	54 449
Do. Sundries in process of manufacture		28 740 5 6	41 876
Wagon Department Stores		120 237 4 6	112 884
Do. Sundries in process of manufacture		13 370 1 8	16 143
Permanent Way Stores		483 480 3 4	441 260
Engineering Stores		35 179 4 1	35 526
General Stores		27 350 15 8	28 306
Steamboat Stores		12 333 14 4	10 302
Telegraph Stores		13 637 0 10	14 978
		1 348 052 2 9	1 269 477
Engineering Stores, Joint Lines		35 482 11 6	36 456
Total		£1 383 534 14 3	1 305 933

(D) TRAFFIC EXPENSES.			31st Dec., 1883.
		£ s. d.	
Salaries, Wages, &c., Coaching and Police Departments	£239 839 12 5		236 308
Fuel, Lighting, Water and General Stores	59 793 13 6		57 195
Clothing	10 456 4 7		9 915
Printing—Stationery and Tickets	20 503 4 11		19 598
Joint Station Expenses	16 327 7 7		18 987
Horses, Harness, Parcel Carts, Provender, &c.	10 336 13 8		10 984
		357 256 16 8	352 987
Salaries, Wages, &c., Merchandise Department	427 934 11 11		427 376
Fuel, Lighting, Water, Grease, and General Stores	28 836 1 5		29 680
Clothing	816 13 1		712
Printing, Stationery, &c.	8 886 11 7		9 199
Horses, Harness, Vans, Provender, &c.	87 838 18 9		91 105
Wagon Covers, Ropes, &c.	9 497 2 4		10 488
Joint Station Expenses	12 035 14 5		10 988
Agents' Commission	2 010 5 0		1 891
Hoists, Hydraulic Cranes, &c.	23,626 14 3		30 350
		601 482 12 9	611 739
		£958 739 9 5	964 726

(E) GENERAL CHARGES.			31st Dec., 1883.
		£ s. d.	
Direction		4 537 10 0	4 537
Auditors and Public Accountants		871 13 1	898
Salaries of Secretary, General Manager, Accountants and Clerks	£33 755 8 2		
Office Expenses, Sundries	8 814 14 2		
		42 570 2 4	41 747
Advertising		3 780 13 7	3 630
Fire Insurance		13 810 13 4	13 811
Electric Telegraph Expenses		18 051 3 5	18 965
Railway Clearing House Expenses		15 547 10 3	16 910
Contribution to Superannuation Fund		6 502 18 6	6 312
Schools		1 311 6 11	1 303
Traveling Expenses, Directors, Managers, &c.		1 546 13 3	1 544
Provident and Insurance Societies and Pension Funds		12 124 13 3	10 392
Sundry Expenses, not classed		6 137 0 11	7 325
		£126 791 18 10	127 374

TABLE No. 21.—*Continued.*

(F) STEAMBOAT EXPENSES.	£ s. d.	31st Dec., 1883.
Salaries of Commanders, Wages of Crews, &c.	20 015 2 2	20 189
Repairs, Ship Stores, &c.	6 862 12 8	6 888
Coal and Engineers' Stores	10 773 10 5	10 156
Light and Harbor Dues	7 698 1 11	7 289
General Charges	2 596 3 4	2 652
	47 945 10 6	47 174
Less—Cost of Working Greenore Service	10 048 0 0	9 985
	£37 897 10 6	37 189

STEAMBOAT DEPRECIATION AND INSURANCE ACCOUNT.

	£ s. d.		£ s. d.
To Balance 30th June last	3 223 5 1	By Amount set aside from Revenue this Half-year	15,000 0 0
To Balance	13 301 14 11	By sale of the Telegraph	1 525 0 0
	£16 525 0 0		£16 525 0 0

MILEAGE STATEMENT.

	Miles Authorized.	Miles Constructed	Miles Constructing or to be Constructed.	Miles Worked by Engines.	31st Dec., 1883.
Lines owned by Company	1 576¼	1 542	34¼	1 532¼	1 519
Do. partly owned	86	85	1	163	152
Do. Leased or Rented	141	137	4	203	213¾
Total	1 803¼	1 764	39¼	1 898¼	1 884¾
Lines Worked	30¾	30¾	.....	33¾	33¾
Foreign Lines Worked over	.....	.....	.....	562¾	562¾
Total	1 834	1 794¾	39¼	2 494¾	2 481¼

STATEMENT OF TRAIN MILEAGE.

Passenger Trains	10 258 096	9 796 002
Goods and Mineral Trains	9 438 932	9 802 718
Total	19 697 028	19 598 720

The Baltimore and Ohio Railroad.

This railroad has been selected by the author as a sample of the extreme type of the American system of railroad construction. In this we have a trunk line doing a very large and profitable traffic, constructed in an engineering sense through an extremely difficult country, which obliged the adoption of very sharp curves and steep grades. (See Plate I.)

It is perfectly safe to say that the curves on this road could not be operated safely at any reasonable speed by rolling stock built on the English type, with long and rigid wheel-base; and to have built this road with easy curves, suitable for it, the cost would have been many times what it has; in fact the cost would have been so great, that, as a commercial undertaking, it would have been impracticable. The operating expenses of the Baltimore and Ohio Railroad show that engineers generally have over-estimated the expense of operating sharp curves. The experience of this road shows that with properly constructed rolling stock the expense is comparatively small, and it can be safely operated at high speed.

This road attains a maximum summit elevation of 2 620 feet above the sea, with very sharp curves, yet the total cost of all the coal used on the main stem and branches, aggregating 553 miles, only cost $339 239.73, in a total operating expense of $6 147 658.80, or 5.5 per cent. The annual cost of fuel for each mile of road is $613, which is 6 per cent. interest on $10 216. So if it had been possible to have located a road that would *have saved all the fuel*, the engineer would have been only justified in expending $10 216 per mile additional to accomplish it.

This road has a great many disadvantages to contend with, and no advantages except cheap fuel, which is probably about the same price as on the English roads.

The data about the Baltimore and Ohio Railroad from which these Tables have been constructed, have been taken from the Company's Annual Report for 1883, pages 30 and 44; the line operated embracing the main stem, including Winchester and Potomac, Winchester and Strasburg, Strasburg and Harrisonburg, Metropolitan Branch, Washington City and Point Lookout, and Somerset and Cambria branches, making a total of 553 miles.

By referring to Table 12, showing the annual operating expenses of the Baltimore and Ohio Railroad, the percentage of all the expenses that are affected by good or bad construction amounts to.....	61.3
The English roads average.....	51.8
Balance against Baltimore and Ohio, per cent.....	9.5
Annual operating expenses of Baltimore and Ohio as per Table 12.....	$6 147 666
Annual saving in the working expenses, if the road had been constructed equal to the average English roads, $6 147 666 × .095	584 028
Ditto per mile.....	1 056
This annual saving per mile, capitalized at six per cent.	17 600

Thus it appears that the engineer would have been justified in spending $17 600 only additional, in making the road equal to the English standard of perfection. You can judge how far this would have gone in enlarging the many curves from 600 feet radii to a minimum of half a mile radii, to say nothing of the grade, and the summit elevation.

Mr. James L. Randolph, M. Am. Soc. C. E., Consulting Engineer of the Baltimore and Ohio Railroad, gives the author the following short description of the character of the line:

FIRST DIVISION.

Length of line..... 100 miles.

Baltimore (50′ A. M. T.) to Martinsburgh (415′ A. M. T.)

The road has no notes of the line between Baltimore and Harper's Ferry. The seven miles next to Baltimore, and the forty-three next to Martinsburgh, have curves and tangents about the same as the Second Division. The other fifty miles, in the valley of the Patapsco, has strong curves and few tangents, and is similar to the Third Division.

SECOND DIVISION.

Length of line.....	100 miles.
Martinsburgh (415′ A. M. T.) to Piedmont (919′ A. M. T.)	
Minimum radius of curves.....	1 000 feet.
Degrees turned.....	10 086 = 28 miles.
Total ascent westward.....	778 feet.
Total descent "	274 "
Maximum grade.....	39.6 per mile.
Running time, including stoppages, 2 hours 35 minutes, = ...	38.7 miles per hour.

THIRD DIVISION.

Length of line..... 73¾ miles.
Piedmont (919′ A. M. T.) to Grafton (987′ A. M. T.)
Minimum radius of curves..... 600 feet.
33¾ miles curved, and 5 miles of this less than 650 feet radius.
Degrees turned..... 9 078.
Maximum grade on tangents..... 120 feet.
Maximum grade on curves of 650 feet radius..... 114 feet per mile.
Total ascent westward..... 2 402 "
Total descent " ..... 2 334 "
Running time, including stoppages, 2 hours 38 minutes, = ... 29.3 miles per hour.

FOURTH DIVISION.

Length of line..... 99¼ miles.
Grafton (987′ A. M. T.) to Wheeling (645′ A. M. T.)
Minimum radius of curves..... 600 feet.
Degrees turned..... 14 976.
Length of curved line..... 59¼ miles.
" " straight " ..... 40 "
Length of curvature less than 650 feet radius..... 5½ "
Maximum grade per mile..... 80 feet.
Total ascent westward..... 779 "
Total descent " ..... 1 121 "
Running time, including stoppages, 3 hours 14 minutes, = ... 30.8 miles per hour.
Elevation of summit above mean tide... 2 620 feet.

THE PENNSYLVANIA RAILROAD.

The officers of the Pennsylvania Railroad have kindly sent the author the data given below and that on Plate II. This railroad has justly become celebrated for its thorough management, cheap charges, both for freight and passengers, and the great attention paid to promoting the comfort of the latter.

As will be seen by the profile on Plate II, the road commences at tide level at Philadelphia, runs over an undulating country, crossing

the Blue Ridge at Gallitzin at an elevation of 2 154 feet above tide, terminating at Pittsburgh at 738 feet above tide.

PHILADELPHIA, August 11th, 1885.

Mr. EDWARD BATES DORSEY,
Consulting Engineer,
The American Exhibition,
7 Poultry, London, E. C., Eng.

MY DEAR SIR,—I am pleased to acknowledge receipt of your favor of August 1st, with inclosure. I am glad to know you have taken so warm an interest in the comparison of the various railways throughout the world. There is a great deal that may be said in favor of our American railways, but I think a great deal of criticism can be made against them.

I note what you say, especially in reference to the difference in the compensation which the railway companies receive from different classes of passenger travel. This is a question to which I have given some thought. I am well satisfied that in America what we call parlor or sleeping-car traffic does not pay anything like the returns which the railway companies receive from ordinary passenger travel.

Very truly yours,

G. B. ROBERTS,
President.

PHILADELPHIA, June 11th, 1885.

EDWARD BATES DORSEY, Esq.,
Member of American Soc. C. E.,
London, Eng.

DEAR SIR,—Answering your letter of the 23d ult., which only reached me on the 8th inst., I send you herewith a blue print showing the grade line of the Pennsylvania Railroad from Pittsburgh to Philadelphia.

We have no plan of the line of the road on a small scale from which we could get you a print.

Our curves are generally light, though we have three or four on the line as high as eight degrees, and quite a number of six degrees, but the majority are less than four degrees.

I am not able at the present time to give you the percentage of curvature, but it certainly does not vary much from 33 per cent.

We also inclose you a lithograph of the cross-section of our road-bed, which, I think, has nearly as much effect on the economical working of a railroad as the curvature. We have learned by experience that the cheapest way to operate a railroad is to keep the track in first-class condition at all times.

Respectfully,

WM. H. BROWN,
Chief Engineer.

Cost of Construction Compared.

From the preceding tables, it appears that the average cost of railways in

England, in 1883 was, per mile.....	$202 227
In the United States "	62 176*
Excess in cost of the English.....	$140 051

In England, the land or right of way, Parliamentary expenses, block system, and crossings, cost much more than in the United States, but this is more than balanced by the saving in the price of labor, iron and steel, which constitute most of the cost of railroad construction. These items probably averaged during the construction of the roads one-third cheaper in England than in the United States.

Owing to the high prices of land, high charges for right of way, Parliamentary expenses, the almost universal use of the block system of signals, and the bridges at road-crossings, the cost of construction of the English railroads must necessarily be greater than the American.

Referring to Table 6, it appears that the percentage of the total annual operating expenses that is affected by good or bad construction is 7.9 per cent. greater on the average of all the American railroads than on the average of all the English roads—say eight per cent.

Table 16 shows that the total operating expenses for all the railways of England in 1883 was, per mile, $10 000, and in the United States, for all the railroads it was, per mile, $4 410.

If all the railroads of the United States had been as well constructed as in England, that is, at an additional cost of $140 051 per mile, there would have been saved eight per cent. of the annual operating expenses, which averaged $4 410 per mile; eight per cent. of this amounts to $353, which would have been the amount saved by expending $140 051 more per mile; this equals 0.25 per cent. on the additional cost. In other words, it would have required an additional expenditure in construction of $140 051 per mile, to save annually $353 in working expenses.

On the other hand, if the English railroads had been built on the American plan, at $140 051 per mile less cost, their working expenses would have been increased eight per cent., or $800 per mile annually. To save this, $140 051 has been expended per mile.

* Probably over one-third of this cost is made by inflated or watered stock. If all our railroads had been built as the English built theirs, where all the stock and bonds are sold at or near par, and nearly all the proceeds applied fairly and squarely to the construction or improvement of the roads, the average cost would not be over $40 000 per mile.

Poor's Manual for 1883, which is the best authority on the cost and working of the American railroads, at page iv says: "The actual cost of all the railways in the United States does not exceed $3 787 410 728; this divided by 121 592 miles = $31 148 average cost per mile."

OPERATING EXPENSES OF ENGLISH AND AMERICAN RAILROADS COMPARED.

Explanations.

In order to compare the cost of operating the two systems of railroads, and to ascertain if the greater cost of constructing the English roads gave a corresponding saving in working expenses, Tables Nos. 23, 24, 25 and 26 were computed. The data for the English roads were taken from their semi-annual reports and from the reports of the Board of Trade. Those for the American roads were taken from the reports of the Railroad Commissioners of the States of New York and Massachusetts, and in some cases from the reports of the companies, and in all cases can be considered reliable. In some cases it has been necessary to exercise discretion in analysing the accounts, as different companies have different forms for keeping their books. The railroads of the United Kingdom selected for comparison embrace all the leading roads. The American railroads selected are all located in a country naturally as rough and offering as great, if not greater, physical obstacles to cheap working than that in which the English roads are located. All roads or branches located in level or prairie country have been excluded.

The American roads selected have certainly no advantage in the physical character of the country they pass through.

In order to make the comparison more complete, the selected American roads embrace all kinds of roads, from the large trunk lines down to the small provincial or local roads. All, however, show very uniform workings.

Ton and Passenger Mileage Per Mile of Single Track.

Many prominent railroad men in England have told the author that it is necessary to run the freight trains at great speed in order to clear the track of their enormous business. In order to compare the traffic on the different roads, and to ascertain the force of this assertion, Table No. 24 was constructed, showing the analyses of the traffic of the principal railroads of each country. In this table all the tracks have been reduced to single track, and the ton and passenger mileage calculated upon this basis.

In all returns made by the English railroads, no mention is made of

third or fourth tracks, they being included under the general head of "double or more tracks."*

All the large companies of England have many miles of third and fourth tracks. For the want of reliable data these have not been calculated in their mileage; if these were added, their single track mileage would be largely increased, and, consequently, the traffic per mile would be proportionally reduced.

On the American railroads all tracks have been estimated and included in the single track.

In both countries all sidings and turnouts have been excluded.

The following recapitulation of Table No. 24 embraces the railroads having the most traffic.

TABLE No. 22.

Name of Railroad.	Mileage per Mile of Single Track.	
England.	Passenger.	Ton.
North Eastern	137 000	455 138
Midland	181 272	512 714
London and North Western	233 777	473 912
London, Chatham and Dover	634 036	195 906
London, Brighton and South Coast	547 328	192 778
Great Western	190 111	308 703
Average	320 587	356 525
United States.		
Boston and Albany	272 642	609 686
Boston and Providence	492 863	194 772
New York, New Haven and Hartford	516 694	314 359
New York Central and Hudson River	182 680	927 973
New York, Lake Erie and Western	114 982	1 216 913
Pennsylvania—Pennsylvania Railroad Division	130 235	1 594 898
Average	285 016	809 767

* The returns of the Board of Trade for 1883, in their Table No. 2A, gives the third and fourth track on some of the English railroads. Apparently in some cases sidings are included in this list. In order to be on the safe side, these additions have not been included in the estimate of single-track mileage; by including them, the single track stated in this paper would be increased as follows, viz.:

London and North Western	256 miles.	Great Northern	82 miles.
London and South Western	20 "	London, Brighton and South Coast	28 "
Midland	162 "	Great Western	38 "

From this it appears that the above six American railroads average more than double freight, with only eleven per cent. less passenger traffic than the six English.

The Pennsylvania ton mileage is more than three times that of the Midland, the highest ton mileage on the English list, while their passenger mileage is only 29 per cent. less.

The Boston, New Haven and Hartford in passenger traffic is 19 per cent. less than the London, Chatham and Dover, the highest on the English list, while their freight is 60 per cent. more.

The Boston and Albany has a larger passenger and freight traffic than any of the large or trunk lines of England.

From this showing, it does not appear necessary to run the trains on the English roads any faster in order to clear the tracks of traffic than on the American railroads.

Cost of Fuel.

The management of the railroads of the United Kingdom kindly furnished the author with the cost of coal used on their respective lines. For this information and other courtesies received from them, the author takes this opportunity to return his thanks. As this information was furnished confidentially, hs does not feel justified in giving the exact figures. As a compromise, he has assumed the cost of coal on the lines north and west of London running into the coal-fields at 6s. 8d., or $1.60, per ton of 2 240 lbs., and on most of the roads south of London at 12s. 6d., or $3. In most cases this is somewhat higher than the actual prices given, in some few instances slightly lower, but in all cases sufficiently accurate for comparison. The price given is the cost of coal delivered to the roads, and does not include any charge for transportation on the road consuming it.

The cost of coal on the American railroads running into coal-fields has been taken as the same as on the English railroads running into coal-fields. *i. e.*, $1.60 per ton of 2 240 lbs.

The cost of coal consumed on the New York Central and Hudson River Railroad could not be ascertained from any official source. All through this paper it has been estimated as costing $3.20 per ton of 2 240 lbs.

Wages of Engine-Drivers and Firemen.

After careful inquiry, the average daily wages of the English engine-driver has been taken at 7s. = $1.68, and the American at $3.83. And

that of the English fireman at 4s. = $0.96, and the American at $1.99. To equalize these, the American wages should be reduced 54.6 per cent., but in order to be safe, they have only been reduced 50 per cent.

Repairs and Renewals of Locomotives.

The result as shown by this column in Table No. 23 was a great surprise to the author. He had the impression that the English locomotive on their smooth roads would require less repairs than the apparently weaker American locomotive on our rougher roads, some of which are far from being equal to the English standard.

The average cost of repairs and renewals of locomotives on fourteen railroads in the United Kingdom was 7.8 per cent. of the total operating expenses, against 5.7 per cent., the average of eight American railroads, or say, one-third less.

This is very strong and emphatic contradiction to the often repeated assertion, that the outside-cylinder engines will shake and twist themselves to pieces. A few days since, a prominent railroad man in England told the author that he had thoroughly tried the outside-cylinder engines, but had given them up on account of the great expense of repairs, "that they wriggled themselves to pieces."

As labor constitutes about one-half the cost of locomotive repairs, the wages paid in the United States should be reduced 50 per cent. to equalize them with those paid in England; the average percentage of the cost of repairs and renewals on the American railroads would then be 4.3 per cent. of the total operating expenses, against 7.8 per cent. on the railroads of the United Kingdom, or nearly one-half.

Maintenance of Way.

The average cost on fourteen English railways was 17.8 per cent. of the total operating expenses, while the average on eight American roads was 21.6 per cent., say 4 per cent. more. This apparently should be much larger when we consider the great amount of perishable materials that enter into our construction, the higher wages to our workmen, and our severe winter weather.

Passenger Cars.—Repairs and Renewals.

The cost of repairs and renewals of passenger cars is about the same in the two countries, the average on the English roads for 1 000 pas-

senger miles being $1.27, and on the American $1.34. As 86 per cent. of the travel in the United Kingdom is third class—on the carriages for this no attempt at ornament, finish or comfort is ever made, they being generally little better than our box cars, with cheap seats and cushions—the first cost and repairs should be very small, much less than on ours. This will make the repairs and renewals of the first-class carriages very large, probably over three times what ours cost. This is another argument in favor of the author's previous assertion, that first-class travel, as now conducted on the English railroads, does not pay.

Freight Cars.—Repairs and Renewals.

But little information can be derived from this comparison, owing to no distinction being made in the reports of the tonnage transported in the companies' cars, or in the cars of firms, or cars of outside companies. This makes the cost of repairs and renewals appear very small on trunk lines, and greater on small lines that run their own cars. As over 90 per cent. of the English freight cars are either coal or open flat cars, their cost of repairs and renewals may be less than ours.

Cost of General Management.

This is about the same in both countries, varying from one to two per cent.—averaging two per cent. of the total operating expenses.

Cost of Motive Power.

The author was very much astonished at the motive power costing nearly double on the English railroads what it does on the American, as shown by Table 23. He expected it would be much greater on the latter, owing to their inferior construction and alignment. In fact this comparison, showing the cost of motive power, was commenced to show the American engineer the economy in operating railroads with good road beds, etc., such as the English have, over the generally inferior constructed roads of the United States. To ascertain if this was not a singular coincidence in one year's business, Table No. 26 was constructed, which shows on five of the principal railroads of each country, for the years 1882, 1883 and 1884, the average annual total operating expenses, cost of fuel, cost of labor on motive power, and the cost of repairs and renewals of locomotives.

NAME OF RAILROAD.	Total Operating Expenses, exclusive of Steamboat Expenses, Taxes included.	Fuel.				Wages of Engine Firem	
		Cost.		Percentage on Total Operating Expenses.			
		Total.	Per Ton of 2 240 lbs.	Amount Actually Paid.	On assumed basis that all Fuel Cost at rate of $1.60 per 2 240 lbs. of Coal.	Total Amount Actually Paid.	Percen Opera
							Amou Actual Paid
United Kingdom, 1883.							
Great Northern	$10 047 040	$699 965	$1.60	7.0	7.0	$903 050	9.0
North Eastern	17 250 150	1 150 780	1.60	6.7	6.7	1 640 655	9.5
Midland	19 413 385	1 167 305	1.60	6.0	6.0	2 153 220	11.0
London and North Western	26 156 425	1 386 285	1.60	5.3	5.3	2 295 860	8.8
Great Western	18 978 720	1 017 880	1.60	5.4	5.4	1 584 205	8.4
Great Eastern	9 074 400	793 935	2.00	8.7	7.0	818 870	9.0
South Eastern	4 941 995	422 405	3.00	8.6	4.6	381 985	7.8
London, Chatham and Dover	2 919 750	239 875	3.60	8.2	3.7	197 300	6.8
Caledonian	7 854 970	470 465	1.60	5.9	5.9	668 290	8.5
Glasgow and South Western	2 838 655	184 370	1.60	6.5	6.5	232 660	8.2
North British	6 602 900	379 990	1.60	5.8	5.8	710 760	10.8
Great Southern and Western of Ireland	2 042 055	167 430	.....	8.2	.....	130 705	6.4
London, Brighton and South Coast	5 471 510	547 715	3.00	10.0	5.3	474 690	8.7
London and South Western	8 236 125	716 110	3.00	8.7	4.6	624 690	7.6
Average, 14 Railroads	.....	.....	.....	7.2	5.7	.....	8.6
United States, 1884.							
Boston and Albany	5 785 877	659 592	4.42	11.4	4.1	402 376	6.9
Boston and Lowell	2 074 293	263 490	4.78	12.7	4.2	153 967	7.4
Boston and Maine	2 080 874	234 517	4.48	11.3	4.0	135 420	6.5
Boston and Providence	1 363 119	120 488	4.59	8.8	3.1	93 132	6.8
Old Colony	2 944 277	278 139	4.47	9.5	3.3	215 302	7.3
New York, New Haven and Hartford	4 828 246	450 436	4.39	9.3	3.3	259 758	5.4
New York, Lake Erie and Western	12 069 338	1 242 989	2.40	10.3	6.9	1 019 438	8.4
New York Central and Hudson River	17 849 313	1 956 397	3.20	11.0	5.5	1 338 042	7.5
Pennsylvania—Pennsylvania Division	17 575 106	1 094 534	1.60	6.2	6.2	1 257 956	7.2
Baltimore and Ohio	6 147 666	339 240	1.60	5.5	5.5	456 697	7.4
Average, 10 Railroads	.....	.....	.....	9.6	4.6	.....	7.1

TABLE No. 23.

Analysis of the Operating Expenses of the Principal Railroads in the United Kingdom and United States.

MOTIVE POWER.									MAINTENANCE OF WAY, EXCLUSIVE OF TAXES.		REPAIRS AND RENEWALS OF PASSENGER CARS.		REPAIRS AND RENEWALS OF FREIGHT CARS.		EXPENSES OF GENERAL MANAGEMENT, DIRECTORS, CLERKS, AUDITOR, ETC.		TAXES AND GOVERNMENT DUTIES.		
OF ENGINE-DRIVERS AND FIREMEN.			PERCENTAGE OF COST OF FUEL AND WAGES OF ENGINE-DRIVERS AND FIREMEN TO TOTAL OPERATING EXPENSES.		REPAIRS AND RENEWALS OF LOCOMOTIVES.			PERCENTAGE ON TOTAL OPERATING EXPENSES OF COST OF FUEL, ENGINE-DRIVERS AND FIREMEN, AND OF REPAIRS AND RENEWALS OF LOCOMOTIVES.											
	PERCENTAGE ON TOTAL OPERATING EXPENSES.				PERCENTAGE ON TOTAL OPERATING EXPENSES.														
	Amount Actually Paid.	All American Wages reduced 50 per Cent. to Equalize them with the English.	Amount Actually Paid.	Reducing all Fuel to $1.60 per Ton of Coal of 2 240 lbs., and American Wages 50 Per Cent.	Total Amount Actually Paid.	Amount Actually Paid.	One half of the cost being Labor, which is reduced 50 per Cent. to Equalize it with the English Price.	Amount Actually Paid.	All Coal reduced to $1.60 per Ton of 2 240 lbs., and all American Wages 50 per Cent.	Amount paid. (Note.—This column, from reports of the English Company, differs somewhat from Board of Trade Reports.)	Percentage on Total Operating Expenses.	Amount Paid.	Total cost in Repairs and Renewals of Cars in Transporting 1 000 Passengers 1 Mile.	Amount Paid.	Total cost in Repairs and Renewals of Cars in Transporting 1 000 Tons 1 Mile.	Amount Paid.	Percentage on Total Operating Expenses.	Amount Paid.	Percentage on Total Operating Expenses.	Percentage of Total Operating Expenses to Gross Earnings Taxes included
0	9.0	9.0	16.0	16.0	$680 635	6.8	6.8	22.8	22.8	$1 422 840	14.2	$402 085	$1.40	$440 040	$ .88	$191 745	1.9	$702 275	6.9	56
5	9.5	9.5	16.2	16.2	1 994 480	11.6	11.6	27.8	27.8	3 326 640	19.3	599 750	1.65	365 388	.32	262 400	1.5	1 001 490	5.8	51
0	11.0	11.0	17.0	17.0	1 803 705	9.3	9.3	26.3	26.3	3 380 195	17.4	852 445	1.99	1 179 450	.97	261 675	1.4	1 222 285	6.3	52
0	8.8	8.8	14.1	14.1	1 839 260	7 0	7.0	21.1	21.1	4 633 020	17.7	953 135	1.28	693 960	.46	378 995	1.5	1 807 840	6.9	51
5	8.4	8.4	13.8	13.8	1 855 190	9.8	9.8	23.6	23.6	4 577 325	24.1	761 905	1.19	771 915	.74	332 325	1.8	1 548 350	8.2	50
0	9.0	9.0	17.7	16.0	765 990	8.4	8.4	26.1	24.4	1 481 740	16.3	348 395	.91	415 980	1.12	156 240	1.7	695 985	7.7	56
5	7.8	7.8	16.4	12.4	256 290	5.6	5.6	22.0	18 0	713 715	14.7	239 510	.....	120 480	.....	154 580	3.1	663 790	13.4	48
0	6.8	6.8	15.0	10.5	218 395	7.5	7.5	22.5	17.0	449 385	15.4	149 230	.76	68 155	1.12	74 095	2.5	328 175	11.2	53
0	8.5	8.5	14.4	14.4	617 775	7.9	7.9	22.3	22.3	1 107 210	14.1	358 050	1.83	653 705	1.43	119 725	1.5	458 435	5.8	52
0	8.2	8.2	14.7	14.7	237 870	8.4	8.4	23.1	23.1	169 210	20.0	114 030	.....	228 605	.....	69 385	2.5	211 275	7.4	54
0	10.8	10.8	16.6	16.6	370 735	6.7	6.7	23.3	23.3	1 263 895	19.0	210 315	1.08	491 565	1.25	110 255	1.7	368 295	5.6	51
5	6.4	6.4	14.6	.....	178 045	8.7	8.7	23.3	.....	504 855	25.0	83 730	.....	91 765	.....	34 245	1.7	141 185	6.9	50
0	8.7	8.7	18.7	14.0	377 215	6.8	6.8	25.5	20.8	825 170	15.8	354 175	.96	140 795	1.08	114 670	2.1	631 420	11.5	51
0	7.6	7.6	16.3	12.0	371 020	4.5	4.5	20.8	16.7	1,471 190	17.9	351 591	.88	264 890	1.23	150 860	1.8	643 995	7.8	59
...	8.6	8.6	15.8	14.5	.....	7.8	7.8	23.6	22.1	.....	17.9	.....	.....	.....	.....	.....	1.9			
6	6.9	3.5	18.3	7.2	391 757	6.8	5.1	25.1	12.3	1 344 731	23.3	173 622	1.04	406 785	1.09	119 544	2.1	522 850	9.0	71
7	7.4	3.7	20.1	7.5	128 354	6.2	4.6	26.3	12.1	476 903	23.0	90 277	1.47	122 823	2.07	51 734	2.5	113 041	5.5	72
0	6.5	3.3	17.8	6.9	116 698	5.6	4.2	23.4	11.1	444 299	21.4	90 871	1.01	55 827	1.24	57 927	2.8	126 757	6.1	67
2	6.9	3.5	15.7	6.3	82 674	6.7	5.0	22.4	11.3	364 026	25.9	97 695	1.77	39 324	1.80	33 726	2.5	103 832	7.6	79
2	7.3	3.7	16.8	6.7	142 436	4.8	3.6	21.6	10.3	833 043	28.3	147 112	1.26	93 459	1.61	60 920	2.1	199 363	6.8	72
8	5.8	2.9	15.1	5.9	155 425	3.2	2.4	18.3	8.3	1 097 891	22.7	278 546	1.35	103 257	.82	102 486	2.1	325 515	6.7	71
8	8.4	4.2	18.7	11.1	491 902	4.1	3.1	22.8	15.2	1 757 243	14.5	254 076	1.49	733 089	.48	166 595	1.4	301 323	2.5	70
2	7.5	3.8	18.5	9.3	865 184	4.9	3.7	23.4	13.0	3 088 032	17.3	509 178	1.31	1 178 034	.51	170 645	1.0	999 866	5.6	70
6	7.2	3.6	13.4	9.8	1 497 444	8.5	6.4	21.9	16.2	3 295 064	18.8	433 642	1.77	1 689 021	.57	202 109	1.1	466 271	2.7	58
7	7.4	3.7	12.9	9.2	624 146	10.1	7.6	23.0	16.8	1 385 376	22.5	299 387	.....	709 029	.....	.....	.....	.....	.....	56
...	7.1	3.6	16.7	8.0	.....	6.1	4.6	22.8	12.7	.....	21.8	.....	.....	.....	.....	.....	1.9			

23.

in the United Kingdom and United States.

Maintenance of Way, exclusive of Taxes.		Repairs and Renewals of Passenger Cars.		Repairs and Renewals of Freight Cars.		Expenses of General Management, Directors, Clerks, Auditor, etc.		Taxes and Government Duties.		Percentage of Total Operating Expenses to Gross Earnings, Taxes included.	Dividends Paid. Per Cent.	NAME OF RAILROAD.
Amount paid. (Note.—This column, from reports of the English Company, differs somewhat from Board of Trade Reports.)	Percentage on Total Operating Expenses.	Amount Paid.	Total cost in Repairs and Renewals of Cars in Transporting 1 000 Passengers 1 Mile.	Amount Paid.	Total cost in Repairs and Renewals of Cars in Transporting 1 000 Tons 1 Mile.	Amount Paid.	Percentage on Total Operating Expenses.	Amount Paid.	Percentage on Total Operating Expenses.			
												UNITED KINGDOM, 1883.
$1 422 840	14.2	$402 085	$1.40	$440 040	$ .88	$191 745	1.9	$702 275	6.9	56	4½	Great Northern.
3 326 640	19.3	599 750	1.65	365 388	.32	262 400	1.5	1 001 490	5.8	51	8½	North Eastern.
3 380 195	17.4	852 445	1.99	1 179 450	.97	261 675	1.4	1 222 285	6.3	52	5½	Midland.
4 633 020	17.7	953 135	1.28	693 960	.46	378 995	1.5	1 807 840	6.9	51	7½	London and North Western.
4 577 325	24.1	761 905	1.19	771 915	.74	332 325	1.8	1 548 350	8.2	50	6½	Great Western.
1 481 740	16.3	348 395	.91	415 980	1.12	156 240	1.7	695 985	7.7	56	1½	Great Eastern.
713 715	14.7	239 510	.....	120 480	.....	154 580	3.1	663 790	13.4	48	5	South Eastern.
449 385	15.4	149 230	.76	68 155	1.12	74 095	2.5	328 175	11.2	53	Nil.	London, Chatham and Dover.
1 107 210	14.1	358 050	1.83	653 705	1.43	119 725	1.5	458 435	5.8	52	4½	Caledonian.
169 210	20.0	114 030	.....	228 605	.....	69 385	2.5	211 275	7.4	54	5½	Glasgow and South Western.
1 263 895	19.0	210 315	1.08	491 565	1.25	110 255	1.7	368 295	5.6	51	4½	North British.
504 855	25.0	83 730	.....	91 765	.....	34 245	1.7	141 185	6.9	50	5	Great Southern and Western of Ireland.
825 170	15.8	354 175	.96	140 795	1.08	114 670	2.1	631 420	11.5	51	4½	London, Brighton and South Coast.
1,471 190	17.9	351 591	.88	264 890	1.23	150 860	1.8	643 995	7.8	59	5½	London and South Western.
.....	17.9	.....	.....	.....	.....	.....	1.9					Average, 14 Railroads.
												UNITED STATES, 1884.
1 344 731	23.3	173 622	1.04	406 785	1.09	119 544	2.1	522 850	9.0	71	8	Boston and Albany.
476 903	23.0	90 277	1.47	122 823	2.07	51 734	2.5	113 041	5.5	72	5½	Boston and Lowell.
444 299	21.4	90 871	1.01	55 827	1.21	57 927	2.8	126 757	6.1	67	8	Boston and Maine.
364 026	25.9	97 695	1.77	39 324	1.80	33 726	2.5	103 832	7.6	79	8	Boston and Providence.
833 043	28.3	147 112	1.26	93 459	1.61	60 920	2.1	199 363	6.8	72	7	Old Colony.
1 097 891	22.7	278 546	1.35	103 257	.82	102 486	2.1	325 515	6.7	71	10	New York, New Haven and Hartford.
1 757 243	14.5	254 076	1.49	733 089	.48	166 595	1.4	301 323	2.5	70	Nil.	New York, Lake Erie and Western.
3 088 032	17.3	509 178	1.31	1 178 034	.51	170 645	1.0	999 866	5.6	70	8	New York Central and Hudson River.
3 295 064	18.8	433 642	1.77	1 689 021	.57	202 109	1.1	466 271	2.7	58	8½	Pennsylvania—Pennsylvania Division.
1 385 376	22.5	299 387	.....	709 029	.....	.....	.....	.....	.....	56	10	Baltimore and Ohio.
.....	21.8	.....	.....	.....	.....	.....	1.9					Average, 10 Railroads.

NAME OF RAILROAD.	Total Length of Line Operated.	TRACKS, EXCLUSIVE OF SIDINGS AND TURN-OUTS.					
		Single Track.	Two Tracks.	Three Tracks.	Four Tracks.	Total, all reduced to Single Track.	Total. Number.
	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	
UNITED KINGDOM, 1883.							
Great Northern	768	768	604	.....	.....	1 372	23 791 706
North Eastern	1 534	1 534	1 014	.....	.....	2 548	35 473 369
Midland	1 381	1 381	1 003	.....	.....	2 384	31 301 707
London and North Western	1 793	1 793	1 397	.....	.....	3 790	55 084 947
Great Western	2 268	2 268	1 109	.....	.....	3 377	49 508 510
Great Eastern	1 049	1 049	550	.....	.....	1 599	62 342 193
London and South Western	721	721	501	.....	.....	1 222	33 886 691
London, Chatham and Dover	160	160	149	.....	.....	309	29 957 252
Caledonian	877	877	462	.....	.....	1 339	17 085 464
North British	1 006	1 006	413	.....	.....	1 419	19 119 535
London, Brighton and South Coast	403	403	273	.....	.....	676	41 296 007
Total of all Railroads—United Kingdom	18 681	18 681	10 105	.....	.....	28 786	683 718 137
UNITED STATES, 1884.							
Boston and Albany	384	384	211	10	9	614	8 794 412
Boston and Lowell	550	550	40	.....	.....	590	4 979 943
Boston and Maine	204	204	67	.....	.....	271	7 054 309
Boston and Providence	68	68	44	.....	.....	112	5 482 707
Old Colony	468	468	57	.....	.....	525	7 826 501
New York, New Haven and Hartford	265	265	135	.....	.....	400	7 582 213
New York, Lake Erie and Western	1 029	1 029	446	.....	.....	1 475	5 385 669
New York Central and Hudson River	993	993	514	317	299	2 123	11 057 939
Baltimore and Ohio	553	.....	.....	.....	.....	.....	.....
Pennsylvania Railroad—							
Pennsylvania Division	1 358	1 358	386	106	29	1 879	10 697 474
United Railroads of New Jersey Div.	.....	442	134	.....	.....	576	12 664 050

TABLE No. 24.

Analysis of the Traffic on the Principal Railroads of the United Kingdom and of the United States.

ND TURN-	PASSENGER TRAFFIC.											FREIGHT TRAFFIC.								NAME OF RAILROAD.
	EXCLUSIVE OF SEASON TICKETS.					SEASON TICKETS.			TOTAL PASSENGER MILEAGE.							TOTAL TON MILEAGE.				
Total, all reduced to Single Track.	Total. Number.	Total Receipts in Pounds Sterling.	Average Amount Received from each Passenger	Average Mileage of each Passenger	Total Passengers carried 1 Mile.	Total Number.	Total Receipts in Pounds Sterling.	Total Mileage at the rate of 600 Miles for each Pound Sterling.	Total.	Per Mile of Single Track.	Average Fares per Mile, 1st, 2d and 3d Class in United Kingdom, and 1st only in United States.	Total Number of Tons Transported.	Total Receipt from Freight	Average Receipt or Charge from each Ton.		Average Mileage of each Ton.	Total.	Per Mile of Single Track.	Average Charge per Ton on all Freight Transported, Per Mile.	
Miles.		£	d.	Miles.			£						£	d.	Dollars.	Miles.				
																				UNITED KINGDOM, 1883.
1 372	23 791 706	1 147 375	11.5	10.	236 359 250	16 908	83 588	50 152 800	286 512 050	208 830	$0.0233	9 429 188	2 095 723	53	1.06	53	502 973 520	366 599	$0.02	Great Northern.
2 548	35 473 369	1 528 142	10.3	9.	314 797 252	8 020	73 978	44 386 800	359 184 052	137 000	0.0233	39 760 125	4 832 047	29	.58	29	1 159 691 280	455 138	0.02	North Eastern.
2 384	31 301 707	1 803 079	14.0	12.	371 434 274	17 458	101 196	60 717 600	432 151 874	181 272	0.0233	25 440 702	5 092 958	48	.96	48	1 222 309 920	512 714	0.02	Midland.
3 790	55 084 947	3 216 589	14.0	12.	662 617 334	109 407	138 553	83 131 800	745 749 134	233 777	0.0233	35 754 539	6 299 081	42	.84	42	1 511 779 440	473 912	0.02	London and North Western.
3 377	49 508 510	2 883 122	14.0	12.	593 922 720	24 378	80 172	48 103 200	642 025 920	190 111	0.0233	24 245 829	4 343 705	43	.86	43	1 042 489 200	308 703	0.02	Great Western.
1 599	62 342 193	1 440 281	5.5	4.7	296 697 886	18 898	149 594	89 756 400	386 454 286	241 680	0.0233	7 152 114	1 537 893	52	1.04	52	369 094 320	231 459	0.02	Great Eastern.
1 222	33 886 691	1 553 501	10.9	9.3	320 021 206	104 963	143 924	86 354 400	406 375 606	332 549	0.0233	3 652 770	902 708	59	1.18	59	216 649 920	177 291	0.02	London and South Western.
309	29 957 252	705 517	5.7	4.9	145 336 502	77 913	84 301	50 580 600	195 917 102	634 036	0.0233	2 177 214	252 229	28	.56	28	60 534 960	195 906	0.02	London, Chatham and Dover.
1 339	17 085 464	809 473	11.4	9.8	166 751 438	8 067	48 283	28 969 800	195 721 238	146 170	0.0233	15 205 390	1 880 054	30	.60	30	456 161 700	340 673	0.02	Caledonian.
1 419	19 119 535	778 090	9.8	8.4	160 286 540	17 157	55 733	33 439 800	193 726 340	136 523	0.0233	13 589 297	1 651 013	29	.58	29	396 243 120	279 241	0.02	North British.
676	41 296 007	1 292 382	7.5	6.4	266 230 692	15 105	172 938	103 762 800	369 993 492	547 328	0.0233	2 544 971	542 992	51	1.02	51	130 318 080	192 778	0.02	London, Brighton and South Coast.
28 786	683 718 137	24 049 861	8.4	7.2	4 954 271 366	632 050	1 692 591	1 015 554 600	5 969 825 966	207 387	0.0233	266 382 968	38 701 319	35	.70	35	9 288 316 560	322 320	0.02	Total of all Railroads—United Kingdom.
		Dollars.	Dollars.								1st Class Mileage.		Dollars.							UNITED STATES, 1884.
614	8 794 412	3 193 452	.....	.....	.....	.....	.....	.....	167 402 441	272 642	$0.0191	3 325 517	4 090 302	..	1.23	112	374 347 455	609 686	$0.0109	Boston and Albany.
590	4 979 943	1 301 114	.....	.....	.....	.....	.....	.....	61 343 056	103 971	0.0212	1 477 058	2 779 070	..	1.89	40	59 427 991	100 725	0.0233	Boston and Lowell.
271	7 054 309	1 704 228	.....	.....	.....	.....	.....	.....	89 587 566	330 581	0.0192	958 332	1 095 664	..	1.14	47	44 937 544	165 821	0.0234	Boston and Maine.
112	5 482 707	1 036 546	.....	.....	.....	.....	.....	.....	55 200 708	492 863	0.01878	732 768	614 500	..	.84	30	21 814 483	194 772	0 02817	Boston and Providence.
525	7 826 501	2 188 197	.....	.....	.....	.....	.....	.....	116 745 901	222 373	0.0187	1 597 048	1 741 860	..	1.09	36	57 899 872	110 285	0.03	Old Colony.
400	7 582 213	3 918 409	.....	.....	.....	.....	.....	.....	206 677 775	516 694	0.0196	2 181 250	2 440 919	..	1.12	58	125 743 803	314 359	0.0197	New York, New Haven and Hartford.
1 475	5 385 669	4 675 871	.....	.....	.....	.....	.....	.....	169 599 245	114 982	0.02168	11 071 938	15 773 004	..	1.42	162	1 794 946 519	1 216 913	0.0088	New York, Lake Erie and Western.
2 123	11 057 939	7 533 813	.....	.....	.....	.....	.....	.....	387 829 886	182 680	0.0194	10 212 418	16 434 983	..	1.61	193	1 970 087 115	927 973	0.0083	New York Central and Hudson River.
.....	.....	.....	.....	38.5	.....	.....	.....	.....	59 335 167	.....	.....	.....	.....	..	....	191	817 869 421	.....	.....	Baltimore and Ohio.
																				Pennsylvania Railroad—
1 879	10 697 474	6 115 423	0.57	23.0	.....	.....	.....	.....	244 710 876	130 235	0.02448	21 674 160	24 778 190	..	1.14	124	2 996 892 567	1 594 898	0.00740	Pennsylvania Division.
576	12 664 050	5 699 245	0.45	19.6	.....	.....	.....	.....	248 789 706	431 927	0.02060	9 144 735	7 833 914	..	.86	60	552 423 171	959 070	0.01365	United Railroads of New Jersey Div.

TABLE No. 25.

Analysis of Train Service, etc., on the Principal Railroads of the United Kingdom and of the United States.

UNITED KINGDOM, 1883.	Total Length of Lines Operated. Miles.	All reduced to Single Track. Miles.	PASSENGER TRAIN MILEAGE.		PASSENGER MILEAGE.		FREIGHT TRAIN MILEAGE.		TON MILEAGE.		Total Freight and Passenger Train Mileage per Mile of Single Track.
			Total.	Per Mile of Single Track.	Total.	Average per Train-Mile.	Total.	Per Mile of Single Track.	Total.	Average per Train-Mile.	
Great Northern	768	1 372	8 091 256	5 890	286 512 050	35.4	8 238 177	6 005	502 973 520	61.5	11 895
North Eastern	1 534	2 548	9 681 906	3 800	359 184 05[illegible]	37.1	14 763 232	5 798	1 159 691 280	78.5	9 598
Midland	1 381	2 384	13 105 400	5 493	432 151 87[illegible]	32.9	19 981 855	8 382	1 222 309 920	61.0	13 875
London and North Western	1 793	3 190	18 931 111	5 935	745 749 134	39.4	19 395 461	6 080	1 511 779 440	78.0	12 015
Great Western	2 268	3 377	14 298 157	4 234	642 025 920	44.9	16 047 939	4 752	1 042 489 200	65.0	8 986
Great Eastern	1 049	1 599	8 486 358	5 307	386 454 286	45.5	5 334 027	3 336	369 094 320	69.2	8 643
South Eastern	370	699	4 930 330	7 053	326 660 480	66.3	1 416 949	2 027	121 009 920	85.4	9 080
London, Chatham and Dover	160	309	3 152 677	10 202	195 917 102	62.2	678 173	2 195	60 534 960	89.5	12 397
Caledonian	877	1 339	5 232 096	3 908	195 721 238	37.4	6 617 610	4 942	456 161 700	68.9	8 850
Glasgow and South Western	332	571	2 230 838	3 907	92 966 400	41.7	2 294 680	4 020	154 419 120	67.0	7 927
North British	1 006	1 419	5 032 790	3 547	193 726 340	38.5	6 428 496	4 537	396 243 120	61.3	8 084
Great Southern and Western of Ireland	478	673	1 678 691	2 494	66 844 142	39.8	1 164 993	1 730	86 676 000	74.4	4 224
London, Brighton and South Coast	403	676	6 521 451	9 648	369 993 492	56.7	1 427 306	2 111	130 318 080	91.0	11 759
London and South Western	721	1 222	8 001 548	6 548	406 375 606	50.8	3 045 365	2 492	216 649 920	71.0	9 040
UNITED STATES, 1884.											
Boston and Albany	384	614	1 949 970	3 176	167 402 441	85.9	3 010 215	4 903	374 347 455	124.3	8 079
Boston and Lowell	550	590	1 305 150	2 212	61 343 056	47.0	610 162	1 031	59 427 991	97.4	3 243
Boston and Maine	204	271	1 289 545	4 759	89 587 566	69.5	540 028	1 993	44 937 544	83.2	6 752
Boston and Providence	68	112	727 348	6 494	55 200 708	76.0	246 298	2 200	21 814 483	88.6	8 694
Old Colony	468	525	1 629 344	3 104	116 745 901	71.6	799 610	1 523	57 899 872	72.4	4 627
New York, New Haven and Hartford	265	400	2 365 746	5 914	206 677 775	87.3	1 461 939	3 655	125 743 803	86.0	9 569
New York, Lake Erie and Western	1 029	1 475	3 791 414	2 571	169 599 245	44.8	7 513 873	5 098	1 794 946 519	239.0	7 669
New York Central and Hudson River	993	2 123	6 425 258	3 027	387 829 886	60.4	10 027 577	4 700	1 970 087 115	196.5	7 727
Pennsylvania—Pennsylvania Division	1 358	1 879	5 775 873	3 074	243 298 222	42.1	15 015 905	8 000	3 082 499 986	205.0	11 074
Pennsylvania—United Railroads of New Jersey Division	443	576	4 168 381	7 237	248 789 706	60.0	4 240 545	7 362	552 423 171	130.0	14 599

TABLE No. 26.

Comparison of the Average Annual Cost of Motive Power on Five of the Principal Railroads of England and the United States, for the Years 1882, 1883 and 1884.

Name of Railroad.	Total Operating Expenses, less Steamboat Expenses, Taxes and Duties.	Fuel.			Wages of Engine-drivers and Firemen.			Repairs and Renewals of Locomotives.			Total percentage of Fuel; wages of Engine-drivers & Firemen; and Repairs and Renewals of Locomotives to Operating Expenses.	
		Amount actually Paid.	Percentage on Operating Expenses.		Amount Paid.	Percentage on Operating Expenses.		Amount actually Paid.	Percentage on Operating Expenses.		Amount actually Paid.	All reduced to English Prices.
			Amount actually Paid.	All reduced to English prices ($1.60 per ton of 2 240 pounds).		Amount actually Paid.	All reduced 50 per cent. to English Prices.		Amount actually Paid.	One-half of Cost of Repairs being Labor, which is here reduced 50% to equalize it with the English.		
England.												
a Great Northern	£1 998 954	£132 495	6.6	6.6	£177 270	8.9	8.9	£135 734	6.8	6.8	22.3	22.3
a North Eastern	3 253 949	219 879	6.8	6.8	317 567	9.8	9.8	405 114	12.5	12.5	29.1	29.1
a Midland	3 607 350	227 303	6.3	6.3	425 629	11.8	11.8	351 702	9.8	9.8	27.9	27.9
a London and North Western	4 845 722	271 191	5.6	5.6	453 566	9.4	9.4	364 411	7.5	7.5	22.5	22.5
a c Great Western (2½ years)	3 512 520	195 945	5.6	5.6	315 892	9.0	9.0	372 298	10.6	10.6	25.2	25.2
Average	.....	.....	6.2	.....	.....	9.8	9.8	.....	9.4	9.4	25.0	25.0
United States.												
b Boston and Albany	$5 353 344	$702 442	13.1	4.2	$406 688	7.4	3.7	$417 792	7.8	5.9	28.3	13.8
b New York, New Haven and Har.	4 205 166	429 977	10.2	4.2	252 301	6.0	3.0	152 469	3.6	2.7	19.8	9.9
b New York, Lake Erie and W.	13 248 239	1 370 670	10.3	6.9	1 114 471	8.4	4.2	632 474	4.8	3.6	23.5	14.5
b New York Central and H. R.	18 345 765	2 224 221	12.1	6.0	1 356 155	7.4	3.7	1 028 562	5.6	4.2	25.1	14.3
a Penn. R. R.—Penn. R. R. Div.	17 383 519	1 109 874	6.4	6.4	1 237 749	7.1	3.5	1 479 675	8.5	6.4	22.0	16.3
Average	.....	.....	10.4	5.5	.....	7.3	3.6	.....	6.1	4.6	23.7	13.8

a This data taken from reports of the company.
b This data taken from report of the Railroad Commissioners of New York and Massachusetts.
c Returns for the six months ending June 30th, 1884, could not be obtained, consequently they are omitted.
All charges for steamboat expenses have been deducted from the operating expenses.

The English roads were selected as being five of the roads doing the heaviest and largest traffic in the United Kingdom. The American five roads were selected from the Eastern system of roads, with the exception of the New York, New Haven and Hartford, built through a country more broken physically than that in which the English roads are located.

From this table, it appears that the greater cost in motive power of operating the English over the American railroads, as shown by Table 23, is not an accidental coincidence of one year, but is fully sustained by three years' working on five of the principal railroads in each country.

Supposing that the longer ton and passenger haulage of the above American lines influenced the result in their favor, the same calculation on the same basis, except the taxes are included in operating expenses, has been made for 1884, on the following short railroads of Massachusetts, where the average haulage is very short.

TABLE No. 27.

Name of Railroad.	Percentage on Operating Expenses, all Reduced to the Price Paid in England.			
	Coal.	Wages.	Repairs and Renewals of Locomotives.	Total.
Boston and Lowell.....	4.2	3.7	4.7	12.6
Boston and Maine.....	4.0	3.3	4.2	11.5
Boston and Providence.....	3.1	3.5	5.0	11.6
Old Colony.....	3.3	3.7	3.6	10.6
Average.....	3.6	3.6	4.4	11.6

The results of the workings of these small and short railroads are still more favorable to the American system.

As an additional check upon the cost of motive power on the American railroads, Table No. 28 was compiled. This contains an analysis of the cost of motive power on sixteen of the principal railroads of Massachusetts for the years 1883 and 1884. This table fully confirms the previous deductions, though this is hardly fair to the American railroads, as most of the roads in this table operate short lines and do small business,

consequently they cannot afford to keep up an efficient staff and have such thorough management as the large railroads of America or England. Moreover, as their consumption is small, they cannot buy their coal and other supplies on such advantageous terms as the larger consumers.

Cost per Train Mile.

In order to meet the views of those accustomed to compare the cost of train miles, Table No. 29 was made. The English make no separate return of the cost of motive power in freight and passenger traffic, so, for this table it was necessary to add the two together and take the aggregate train mileage. In consequence of the size of the trains varying so much in the two countries; the variation between different roads of the proportion between passenger and freight trains, which makes a proportionate variation in the cost of operating; and the absence of all official data from the English roads regarding their ton and passenger mileage; these deficiencies, in the opinion of the author, make this table less reliable than the previous ones, where the cost of motive power and other expenses were compared, by taking their percentage to the total operating expenses; for in roads constructed in similar countries, the different items of operating expenses should bear a close proportionate percentage to each other.

In order to be safe beyond all question, the Massachusetts railroads have been largely used for comparison. These have no advantage whatever over the English roads, being with one exception all short lines with short haulage, located in a rough and broken country. In every respect they are more unfavorably situated for cheap working than the average of the English roads. Moreover, the Reports of the Railroad Commissioners of Massachusetts are as reliable as those of the English Board of Trade, and much more thorough and complete—these give very reliable data for comparison.

In the repairs of locomotives, in the English cost there has been included nothing except the actual material and labor used in the repairs, while in the American cost is included superintendence, cost and repairs of tools, shop, etc. This would make the difference in the cost still greater if these items were added to the English cost.

In Table No. 29, after reducing the cost down to the English standard of prices, the average of six American railroads cost in motive power

Analysis of the Cost of Motive Power on Sixteen o

	Length of Road Operated. Miles.	Total Operating Expenses, exclusive of Taxes.	FUEL. Total Amount Paid.	Price per Ton of 2 240 lbs.	Tons of Coal.	Cord of Wood
Boston and Albany, 1883	374	$5 668 718	$795 383	$5.40	145 709	2 34
" 1884	384	5 263 027	659 592	4.40	148 200	2 48
" average	....	5 465 873	727 488	4.90	.....	.....
Fitchburg, 1883	189	2 045 547	311 785	5.09	60 842	46
" 1884	189	1 979 609	296 577	4.62	63 845	51
" average	....	2 012 578	304 181	4.86	.....	.....
Boston and Lowell, 1883	170	1 431 240	198 069	5.02	38 378	39
" 1884	550	1 961 252	263 490	4.78	43 020	18 20
" average	....	1 696 246	230 780	4.90	.....	.....
Boston and Maine, 1883	204	1 955 496	252 602	4.94	50 908	38
" 1884	204	1 954 117	234 517	4.48	52 251	22
" average	....	1 954 807	243 560	4 71	.....	.....
Eastern, 1883	285	2 239 721	294 056	4.63	59 670	5 81
" 1884	285	2 235 325	284 321	4.46	60 477	4 88
" average	....	2 237 523	289 189	4.55	.....	.....
Boston and Providence, 1883	68	1 220 149	120 790	4.92	24 574	.....
" 1884	68	1 259 287	120 488	4.59	26 222	.....
" average	....	1 239 718	120 639	4.76	.....	.....
Old Colony, 1883	468	3 057 361	310 465	5.20	59 281	6
" 1884	468	2 744 914	278 140	4.47	62 013	3
" average	....	2 901 138	294 303	4.84	.....	.....
Providence and Worcester, 1883	50	793 959	76 198	5.59	13 642	.....
" 1884	50	819 030	75 143	4.85	15 520	.....
" average	....	803 495	75 670	5.22	.....	.....
New Haven and Northampton, 1883	173	564 788	68 663	4.60	14 927	.....
" 1884	173	541 613	64 243	4.60	16 061	.....
" average	....	553 200	66 453	4.30	.....	.....
New London Northern, 1883	121	462 904	74 280	5.00	13 681	1 7
" 1884	121	318 974	54 692	4.20	11 451	2 3
" average	....	390 939	64 486	4.60	.....	.....
New York and New England, 1883	378	3 036 469	475 197	3.59	132 292	.....
" 1884	378	2 816 610	415 464	3.82	108 623	.....
" average	....	2 926 540	445 330	3.71	.....	.....
Cheshire, 1883	64	454 556	102 386	6.23	9 822	9 9
" 1884	64	386 635	98 950	6.08	8 927	11 0
" average	....	420 596	100 668	6.16	.....	.....
Connecticut River, 1883	80	588 563	92 222	6.00	13 651	2 7
" 1884	80	568 224	88 985	5.68	13 886	2 6
" average	....	578 394	90 604	5.84	.....	.....
Norwich and Worcester, 1883	66	453 420	60 617	4.80	12 599	
" 1884	66	418 687	48 689	4.30	11 234	
" average	....	436 054	54 653	4.55	.....	.....
Worcester, Nashua and Rochester, 1883	94	471 520	89 099	5.95	14 970	.....
" 1884	94	444 320	72 752	5.16	14 094	.....
" average	....	457 920	80 926	5.55	.....	.....
New York, New Haven and Hartford, 1883	265	4 205 166	429 977	4.34	98 682	1
" " " 1884	265	4 205 166	429 977	4.19	102 654	.....
Average of three years, 1882, 1883 and 1884	....	4 205 166	429 977	4.27	.....	.....
Total	3 240	56 566 467	7 237 919	.....	1 522 106	67 3
Average—16 Massachusetts Railroads	....	.....	.....	4.62	.....	.....
" 14 Railroads of United Kingdom, from Table 23	....	.....	.....	.....	.....	.....

1½ cords of w

TABLE No. 28.

r on Sixteen of the Principal Railroads of Massachusetts in the Years 188

FUEL.					WAGES OF ENGINE-DRIVERS AND FIREMEN.		
Tons of Coal.	Cords of Wood.	Total Tons of Coal, 1½ Cords of Wood = 1 Ton of Coal.	Percentage on Operating Expenses.		Total Amount Paid.	Percentage on Operating Expenses.	
			Amount Paid.	Reduced to $1.60 per Ton of 2 240 lbs.		Amount Paid.	Reduced 50 % to Equalize with English Prices.
145 709	2 348	.....	....	....	$414 643	....	....
148 200	2 480	.....	....	....	402 376	....	....
.....	.....	.....	13.3	4.4	408 510	7.4	3.7
60 842	462	.....	....	....	176 329	....	....
63 845	518	.....	....	....	184 964	....	....
.....	.....	.....	15.1	5.0	180 647	8 9	4.5
38 378	397	.....	....	....	115 553	....	....
43 020	18 203	....	....	....	153 968	....	....
.....	.....	.....	13.6	4.4	134 760	7.9	3.9
50 908	381	.....	....	....	128 386	....	....
52 251	221	.....	....	....	135 419	....	....
.....	.....	.....	12.5	4.2	121 903	6.7	3.4
59 670	5 813	.....	....	...	166 284	....	....
60 477	4 886	.....	...	....	170 715	....	....
.....	.....	.....	12.9	4.5	168 499	7.5	3.7
24 574	.....	.....	....	....	87 327	....	....
26 222	.....	.....	....	....	95 132	....	....
.....	.....	.....	9.7	3.4	91 230	7.4	3.7
59 281	633	.....	....	....	215 874	....	....
62 013	339	.....	....	....	215 302	....	....
.....	.....	.....	10.1	3.4	215 588	7.4	3.7
13 642	.....	.....	....	....	56 557	....	....
15 520	.....	.....	....	....	55 459	....	....
.....	.....	.....	9.4	3.0	56 008	6.9	3.5
14 927	.....	.....	...	....	32 635	....	....
16 061	.....	.....	...	....	26 903	....	....
.....	.....	.....	12.0	4.5	34 769	6.0	3.0
13 681	1 769	.....	....	....	30 431	....	....
11 451	2 338	.....	...	....	26 352	....	....
.....	.....	.....	16.5	5.8	28 392	7.3	3.6
132 292	.....	.....	....	....	233 481	....	....
108 623	.....	.....	....	....	224 220	....	....
.....	.....	.....	15.2	6.6	228 851	7.8	3.9
9 822	9 902	.....	....	....	36 045	....	....
8 927	11 025	.....	...	....	31 385	....	....
.....	.....	.....	23.9	6.2	33 715	8.0	4.0
13 651	2 713	.....	....	....	41 846	....	....
13 886	2 672	.....	....	....	41 470	....	....
.....	.....	.....	15.7	4.3	41 658	7.2	3.6
12 599	40	.....	....	....	37 327	....	....
11 234	60	.....	....	....	35 544	....	....
.....	.....	... .	12.6	4.4	36 436	8.4	4.2
14 970	.....	.....	....	....	29 700	....	....
14 094	.....	.....	....	....	29 980	....	....
.....	.....	.....	17.7	5.2	29 840	6.5	3.3
98 682	133	.....	....	....	252 301	....	....
102 654	.....	.....	....	....	252 301	....	....
.....	.....	.....	10.2	4.2	252 301	6.0	3.0
1 522 106	67 333	1 566 994	....	....	4 146 209	....	....
.....	.....	.....	12.8	4.4	.....	7.4	3.7
.....	.....	.....	7.2	7.2	.....	8.6	8.6

1½ cords of wood calculated to equal one ton of coal.

Years 1883 and 1884.

RIVERS		REPAIRS AND RENEWALS OF LOCOMOTIVES.		Percentage of Cost of Fuel, Wages of Engine-drivers and Firemen, and Repairs and Renewals of Locomotives on Total Operating Expenses.		Dividends Earned. Per Cent.
AGE ON TING SES.	Total Amount Paid.	PERCENTAGE ON OPERATING EXPENSES.				
Reduced 50 % to Equalize with English Prices.		Amount Paid.	Reduced 25 % to Equalize Wages with English.	Amount Actually Paid.	All Reduced to the English Standard of Prices.	
....	$434 726	....	....	....	....	8.2
....	391 757	....	....	....	....	8.1
3.7	413 242	7.6	5.7	28.3	13.8	....
....	125 710	....	....	....	....	6.4
....	133 792	....	....	....	....	5.4
4.5	129 751	6.4	4.8	30.4	14.3	....
....	90 183	....	....	....	....	6.5
....	128 354	....	....	....	....	5.7
3.9	109 269	6.4	4.8	27.9	13.1	....
....	106 743	....	....	....	....	8.2
....	116 698	....	....	....	....	8.2
3.4	111 721	5.7	4.3	24.9	11.9	....
....	202 854	....	....	....	....	4.0
....	174 921	....	....	....	....	3.8
3.7	188 888	8.4	6.3	28.8	14.5	....
....	84 568	....	....	....	....	8.2
....	82 674	....	....	....	....	8.2
3.7	83 621	6.7	5.0	23.8	12.1	....
....	194 193	....	....	....	....	6.0
....	142 436	....	....	....	....	7.0
3.7	168 315	5.8	4.3	23.3	11.4	....
....	29 680	....	....	....	....	8.5
....	59 204	....	....	....	....	6.8
3.5	44 442	5.5	4.1	21.8	10.6	....
....	47 717	....	....	....	....	Nil.
....	35 245	....	....	....	....	Nil.
3.0	41 481	7.5	5.6	25.5	13.1	....
....	69 329	....	....	....	....	6.0
....	18 675	....	....	....	....	6.0
3.6	44 002	11.3	8.5	35.1	17.9	....
....	332 086	....	....	....	....	Nil.
....	331 141	....	....	....	....	Nil.
3.9	331 614	11.4	8.6	34.4	19.1	....
....	27 367	....	....	....	....	2.8
....	30 574	....	....	....	....	3.5
4.0	28 970	6 9	5.2	38.8	15.4	....
....	30 209	....	....	....	....	9.5
....	33 906	....	....	....	....	9.1
3.6	32 058	5.6	4.2	28.5	12.1	....
....	29 425	....	....	....	....	8.6
....	28 030	....	....	....	....	8.1
4.2	28 728	6.6	5.0	27.6	13.6	....
....	41 432	....	....	....	....	3.3
....	39 105	....	....	....	....	2.6
3.3	40 269	8.8	6.6	33.0	15.1	....
....	152 469	....	....	....	....	10.2
....	152 469	....	....	....	....	10.1
3.0	152 469	3.6	2.7	19.8	9.9	....
....	3 897 672	....	....	....	....	....
3.7	.....	6.9	5.2	27.1	13.3	....
8.6	.....	7.8	7.8	23.6	23.6	....

$0.021, or 14 per cent. less per train mile than the average cost of six English railroads, notwithstanding that the average load of the American train was more than double in tons, and over 50 per cent. more in passengers. This corresponds very closely with the result obtained by calculating upon the percentage basis.

The London and North Western, of England, and the Boston and Albany, of the United States, have each about double the ton mileage to that of their passenger mileage, consequently they offer a good basis for comparison. The motive power (the prices being reduced to the English rates) costs the same per train mile. The American road, however, averaged 60 per cent. more load on their freight trains, and more than double the load on their passenger trains.

The London and North Western Railway had in 1883 a total passenger train mileage of 18 931 111. Supposing that they carried the same average load as the Boston and Albany did in 1884, *i. e.*, 85.9, this will give a total passenger mileage of $18\ 931\ 111 \times 85.9 = 1\ 626\ 182\ 435$. The total receipts from all classes of passengers were £3 355 142; dividing the total passenger mileage as above into this, gives .495d. as the average fare per mile paid by each passenger, first, second and third-class included.

In 1883 the London and North Western Railway ran 19 395 461 freight train miles. Supposing that they transported the same average load as the Boston and Albany did in 1884, *i. e.*, 124.3 tons, this will give a total ton mileage of $19\ 395\ 461 \times 124.3 = 2\ 410\ 855\ 802$; dividing this into £6 299 081, the total amount received from freight traffic, gives .627d. as the average price paid per ton per mile.

These equated prices are less than one-half of the actual or ruling prices.*

The Great Eastern, of England, and the Boston and Lowell, of the United States, also offer a good basis for comparison, as each have about equal passenger mileage to their ton mileage. Reducing all to the English standard of prices, the American road is operated at $0.026, or 19 per cent. less cost per train mile than the English, while the freight load of the American train is 40 per cent. larger and the passenger load five per cent. greater.

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* The present freight charge by the London and North Western Railway from Manchester to Liverpool, 29 miles, is 9s. 2d. or $2.20 per ton of 2 240 pounds for goods in bales and cases, being about 7.6 cents per ton per mile.

TABLE No. 29.

Cost of Motive Power per Train Mile on Six English and Six American Railroads.

NAME OF RAILROAD.	TOTAL MILEAGE.			AVERAGE LOAD OF TRAIN.		AVERAGE MILEAGE.	
	Train. Passenger and Freight.	Passenger. (For English Railroads calculated as stated on page 17.)	Ton. (For English Railroads calculated as stated on page 16.)	Passenger. Number of Passengers Per Mile of Passenger Train.	Freight. Number of Tons Per Mile of Freight Trains.	Passenger.	Ton.
ENGLAND, 1883.							
Great Northern	16 329 433	288 069 860	502 973 520	35.6	61.5	.....	53
North Eastern	24 445 138	363 647 121	1 159 691 280	37.6	78.5	.....	29
Midland	33 087 255	436 338 084	1 222 309 920	33.3	61.	.....	48
London and North Western	38 326 572	744 151 164	1 511 779 440	39.3	78.	.....	42
Great Western	30 346 096	642 205 320	1 042 489 200	44.9	65.	.....	43
Great Eastern	13 820 385	382 764 707	369 094 320	45.1	69.2	.....	52
Average	.....	.....	.....	39.3	68.9	.....	44.5
UNITED STATES, 1884.							
Boston and Albany	4 960 185	167 402 441	374 347 455	85.9	124.3	.....	112
New York, New Haven and Hartford	3 827 685	206 677 775	125 743 803	87.3	86.	.....	58
New York, Lake Erie and Western	11 305 287	169 599 245	1 794 946 519	44 8	239.	.....	162
New York Central and Hudson River	16 452 835	387 829 886	1 970 087 115	60.4	196.5	.....	193
Pennsylvania—Pennsylvania Railroad Division	20 791 778	244 710 876	2 996 892 567	42.2	205	.....	134
Boston and Lowell	1 915 312	61 343 056	59 427 991	47.	97.4	.....	40
Average	.....	.....	.....	61.3	158.	.....	116.5

TABLE No. 29.—*Continued.*

NAME OF RAILROAD.	FUEL.			WAGES OF ENGINE-DRIVERS AND FIREMEN.			REPAIRS AND RENEWALS OF LOCOMOTIVES.			COST OF FUEL, WAGES OF ENGINE-DRIVERS AND FIREMEN, AND REPAIRS AND RENEWALS OF LOCOMOTIVES, PER TRAIN MILE.	
	AMOUNT ACTUALLY PAID.		Per Train Mile. Coal reduced to $1.60 per ton of 2 240 lbs.	AMOUNT ACTUALLY PAID.		Per Train Mile. All American Wages Reduced 50 Per Cent. to Equalize Them with English Wages.	AMOUNT ACTUALLY PAID.		Per Train Mile. All American Wages Reduced 50 Per Cent. to Equalize Them with English Prices.		
	Total.	Per Train Mile.		Total.	Per Train Mile.		Total.	Per Train Mile.		Amount Actually Paid.	All Reduced to English Prices.
ENGLAND, 1883.											
Great Northern	$699 965	$0.043	$0.043	$903 050	$0.055	$0.055	$680 635	$0.042	$0.042	$0.140	$0.140
North Eastern	1 150 780	.047	.047	1 640 655	.067	.067	1 994 480	.082	.082	.196	.196
Midland	1 167 305	.035	.035	2 153 220	.065	.065	1 803 705	.054	.054	.154	.154
London and North Western	1 386 285	.036	.036	2 295 860	.060	.060	1 839 260	.048	.048	.144	.144
Great Western	1 017 880	.034	.034	1 584 205	.052	.052	1 855 190	.061	.061	.147	.147
Great Eastern	793 935	.057	.040	818 870	.060	.060	765 990	.056	.056	.173	.162
Average	.....	$0.042	$0.040	.....	$0.060	$0.060	.....	$0.057	$0.057	$0.159	$0.157
UNITED STATES, 1884.											
Boston and Albany	$659 592	$0.133	$0.048	$402 376	$0.081	$0.041	$391 757	$00.079	$0.059	$0.293	$0.148
New York, New Haven and Hartford	450 436	.118	.045	259 758	.068	.034	155 425	.040	.030	.190	.109
New York, Lake Erie and Western	1 242 989	.110	.078	1 019 438	.090	.045	491 902	.044	.033	.244	.151
New York Central and Hudson River	1 956 397	.119	.060	1 338 142	.081	.040	865 184	.053	.040	.253	.140
Pennsylvania—Pennsylvania Railroad Division	1 094 534	.053	.053	1 257 956	.060	.030	1 497 444	.072	.054	.185	.137
Boston and Lowell	263 490	.138	.046	153 967	.080	.040	128 354	.067	.050	.285	.136
Average	.....	$0.112	$0.054	.....	$0.077	$0.038	.....	$0.059	$0.044	$0.242	$0.136

In Tables 30 and 31, this method of calculation has been carried out more fully. In these tables can be seen at a glance what would have been the average receipts from each ton or passenger transported one mile, provided the train load had been the same as that carried by the American railroad with which it is compared. To facilitate comparison, the cost of motive power per train mile has been transferred from Table No. 29.

These equated prices are, without exception, much too low, averaging less than half the ruling or present prices. They are so much too small, that any argument based upon them would be absurd.

They show conclusively, that notwithstanding the average train mile costs in motive power less on the American railroads than on the English, yet the American average train load is much greater both in tonnage and passengers.

In order to make the comparison still more comprehensive, Table No. 32 was made. In this all the railroads of Massachusetts, 32 in number, embracing 2 852 miles of operated lines, are compared with all the railroads of England and Wales, embracing 13 340 miles of operated lines. Both systems for the years 1879 to 1884 inclusive, or for six years.

For want of time, the author has not been able to ascertain officially from each railroad included in Table 32, the exact cost of coal consumed. From data given in the previous tables it would be perfectly safe, in his judgment, to estimate the cost of coal consumed on the Massachusetts railroads at three times the price per ton of that consumed on the English and Welsh railroads; but, in order to be conservative, he has only estimated it at double cost. Nearly all the coal consumed on the Massachusetts railroads must be transported over 200 miles by rail or 400 miles by water; with but few exceptions, all the principal railroads of England and Wales run direct into the coal districts. A thorough calculation, based upon the actual prices paid by each railroad, would show the operating expenses of the Massachusetts railroad on the cost of fuel alone to be at least sixteen per cent., or two cents less per train mile than those shown in Table No. 32.

Table No. 32 shows that the average load of passenger trains per passenger train mile in Massachusetts in 1884, was 67 passengers.

In England and Wales in 1884, the total passenger-train mileage was 121 582 978 miles. Suppose that these averaged the same load as the Massachusetts trains did, this will give $121\,582\,978 \times 67 = 8\,146\,905\,526$

TABLE No. 30.

Showing what would have been the Receipts from each Passenger per Mile Transported, First, Second and Third-class included, on the six English Railroads named in Table No. 28, if the Train Load had been the same as that of the American Railroads named in that table.

	Average Load of Passenger Trains. Number of Passengers.	Great Northern.	North Eastern.	Midland.	London and North Western.	Great Western.	Great Eastern.	Cost of Motive Power Per Train Mile. All reduced to English Prices.
Total Passenger Train Mileage.....	....	8 091 256	9 681 906	13 105 400	18 931 111	14 298 157	8 486 358	.....
Total Receipts from Passengers.....	....	£1 230 963	£1 602 120	£1 904 275	£3 355 142	£2 963 292	£1 589 875	.....
Boston and Albany.....	85.9	.43d.	.46d.	.41d.	.50d.	.58d.	.52d.	$0.148
New York, New Haven and Hartford.....	87.3	.42d.	.45d.	.40d.	.49d.	.57d.	.51d.	0.109
New York, Lake Erie and Western.....	44.8	.81d.	.88d.	.78d.	.95d.	1.11d.	1.00d.	0.151
New York Central and Hudson River.....	60.4	.60d.	.66d.	.58d.	.70d.	.82d.	.74d.	0.140
Pennsylvania—Pennsylvania Railroad Division.....	42.2	.86d.	.93d.	.82d.	1.08d.	1.19d.	1.04d.	0.137
Boston and Lowell.....	47.	.78d.	.85d.	.75d.	.90d.	1.06d.	.95d.	0.136
Cost of Motive Power per Train Mile.....	....	$0.140	$0.196	$0.154	$0.144	$0.147	$0.162	.....

TABLE No. 31.

Showing what would have been the Receipts from each Ton Transported one Mile on the Six English Railroads named in Table No. 29, if the Train Load had been the same as that of the American Railroads named in that Table.

	Average Load of Freight Train. Number of Tons.	Great Northern.	North Eastern.	Midland.	London and North Western.	Great Western.	Great Eastern.	Cost of Motive Power per Train Mile. All Reduced to English Prices.
Total Freight Train Mileage	.....	8 238 177	14 763 232	19 981 855	19 395 461	16 047 939	5 334 027	.....
Total Receipts from Freight	.....	£2 095 723	£4 832 047	£5 092 958	£6 299 081	£4 343 705	£1 537 893	.....
Boston and Albany	124.3	.49d.	.63d.	.49d.	.63d.	.52d.	.55d.	$0.148
New York, New Haven and Hartford	86.	.71d.	.91d.	.71d.	.91d.	.76d.	.80d.	0.109
New York, Lake Erie and Western	239.	.26d.	.33d.	.26d.	.33d.	.27d.	.29d.	0.151
New York Central and Hudson River	196.5	.31d.	.40d.	.31d.	.40d.	.33d.	.35d.	0.140
Pennsylvania—Pennsylvania Railroad Division	205.	.29d.	.38d.	.29d.	.38d.	.32d.	.33d.	0.137
Boston and Lowell	97.4	.63d.	.81d.	.58d.	.80d.	.66d.	.68d.	0.136
Cost of Motive Power per Train Mile	.....	$0.140	$0.196	$0.154	$0.144	$0.147	$0.162	.....

passenger miles. The total receipts in 1884 from all classes of passengers on the railroads of England and Wales was £22 247 095; dividing this by their total passenger mileage gives .655d. as the average charge per mile traveled by first, second and third-class.

In England and Wales in 1884, the total freight-train mileage was 106 605 484. Supposing that they averaged the same load as the Massachusetts trains did, *i. e.*, 109 tons, this gives $106\,605\,484 \times 109 = 11\,619\,997\,756$ total ton mileage. The total receipts from freight in 1884 by the English and Welsh railroads was £31 973 111; dividing this by the total ton mileage gives .660d. as the average charge per ton per mile.

These equated charges, when taken together for freight and passenger traffic, are so much below the real prices, being less than half, that no arguments can be based upon them.

Even supposing the average train-loads to be equal in both countries, still the motive power on the English and Welsh railroads costs, on the average, twenty-five per cent. more than on the Massachusetts railroads per train mile, as shown by Table No. 32, notwithstanding the underestimate of the cost of coal consumed.

Locomotive Mileage.

The locomotive with compound engines, as perfected by Mr. F. W. Webb, has given very satisfactory results, and is being largely introduced on the London and North Western Railway.

Mr. Webb kindly furnished the author with the data given in Table No. 33.

"As regards the loads hauled, we may mention that the average train taken between Crewe and Euston by the 'Dreadnought' class, consists of twelve vehicles. On the 19th of March last, the 'Dreadnought' worked the 10 A. M. Scotch express from Euston to Carlisle, a continuous run of 300¼ miles, with an average load, including engine and tender, of 207 tons. On this journey the consumption of fuel averaged 29.2 pounds per mile, and the evaporation of water was 9.49 pounds per pound of coal. The train arrived at Rugby two minutes before time, left four minutes late, and arrived at Carlisle four minutes before time, the Shap incline—5½ miles of 1 in 75—being mounted in ten minutes, and the average running speed over the whole trip being 44.7 miles per hour. Neither the smoke-box or ash-pan was cleared out during the journey, nor was the fire cleaned. The engine steamed freely throughout the run, and the weight of ashes in the smoke-box on the arrival at Carlisle was 40¼ pounds, and in the ash-pan 59¼ pounds. These are certainly most admirable results.

"On March 27th last, also, engine No. 504, 'Thunderer,' worked

TABLE No. 32.

Average Cost per Train Mile for Motive Power on the Aggregate Railroads of England and Wales, and of the State of Massachusetts, for the Years 1879, 1880, 1881, 1882, 1883 and 1884.

Year.		Total Length of Lines Operated. Miles.	Average Miles each Passenger was Transported	Average Miles each Ton was Transported.	Total Train Mileage.	Average Train Load. Passengers.	Average Train Load. Tons	Fuel.	Wages of Engine-drivers and Firemen.	Repairs and Renewals of Locomotives.	Total Average. Pence.	Total Average. Dollars.
1879	England and Wales	.....	.....	.....	.....	.....	.....	*b*	*b*	*b*	8.40	0.1680
"	Massachusetts	2 626	16	56	22 755 910	57	90	$0.048	*a* $0.034	$0.034	.....	.116
1880	England and Wales	.....	.....	.....	202 050 891	.....	.....	*b*	*b*	*b*	8.30	.1660
"	Massachusetts	2 626	16	56	24 075 392	63	98	$0.054	*a* $0.033	$0.042	.....	.139
1881	England and Wales	.....	.....	.....	208 517 549	.....	.....	*b*	*b*	*b*	8.34	.1668
"	Massachusetts	2 755	16	60	27 205 783	64	104	$0.061	*a* $0.034	$0.043	.....	.138
1882	England and Wales	.....	.....	.....	217 393 015	.....	.....	*b*	*b*	*b*	8.37	.1674
"	Massachusetts	2 778	16	59	29 052 800	66	107	$0.060	*a* $0.033	$0.046	.....	.139
1883	England and Wales	13 215	.....	.....	226 351 389	.....	.....	*b*	*b*	*b*	8.41	.1682
"	Massachusetts	2 783	15	60	31 150 823	66	107	$0.062	$0.034	$0.050	.....	.146
1884	England and Wales	13 340	.....	.....	228 972 559	.....*	.....	*b*	*b*	*b*	8.49	.1698
"	Massachusetts	2 852	15	60	32 304 333	67	100	$0.056	$0.033	$0.045	.....	.134
AVERAGE.	England and Wales	.....	.....	.....	.....	.....	.....	*b*	*b*	*b*	8.39	.1678
"	Massachusetts	.....	.....	.....	.....	.....	.....	$0.057	$0.034	$0.043	.....	.134

NOTES.—*a* The author has no official data for these years. The amount given is the average cost for the years 1883 and 1884.

b The Board of Trade includes all these items under the general head of "Locomotive Power," which is included in the total average at the bottom of this column.

In the above table all wages on the American Railroads have been reduced on the basis previously stated, to equalize them with the English and Welsh prices.

All data in the above table relating to the English and Welsh Railroads have been taken from the Reports of the Board of Trade of the United Kingdom; and all relating to the American Railroads have been taken from the reports of the Railroad Commissioners of Massachusetts, embracing in all thirty-two distinct railroads.

TABLE No. 33.

Statement showing the Mileage of the various Compound Engines on the London and North Western Railway, from the Date of commencing Regular Work, to March 31st, 1885, including also the Number of Days working, and the Average Miles per Day.

Number of Engines.	Name.	Regular Working.				Number of Days, Sundays excepted, from Commencement of Regular Work, to March 31st, 1885. (313 days = 1 year.)	
		Date Commenced.	Mileage.	Working Days.			
				Number of Days.	Average Miles per Day.	Number of Days.	Average Miles per Day.
66	Experiment	April 3, 1882	174 908	616	284	937	186
300	Compound	May 2, 1883	96 132	321	299	599	160
301	Economist	May 15, 1883	93 875	312	301	588	158
302	Velocipede	May 25, 1883	89 715	316	284	579	155
303	Hydra	June 1, 1883	90 739	308	294	573	158
305	Trentham	August 8, 1883	83 512	286	292	515	162
306	Knowsley	August 16, 1883	84 104	311	270	508	166
307	Victor	August 22, 1883	85 548	313	273	503	170
310	Sarmatian	April 28, 1884	60 594	248	244	289	209
311	R. F. Roberts	March 28, 1884	53 016	188	282	315	169
315	Alaska	March 31, 1884	54 603	314	174	313	174
321	Servia	April 1, 1884	52 880	299	177	312	169
323	Britannic	April 7, 1884	44 049	254	173	307	143
333	Germanic	April 5, 1884	53 026	295	179	309	171
353	Oregon	April 13, 1884	54 590	291	177	302	181
363	Aurania	April 15, 1884	47 225	261	181	300	157
365	America	April 21, 1884	49 127	275	179	295	167
366	City of Chicago	April 23, 1884	47 243	229	206	293	161
372	Empress	October 8, 1884	25 920	106	244	149	174
374	Emperor	September 10, 1884	29 767	152	195	173	170
503	Dreadnought	September 29, 1884	17 165	59	291	157	109
504	Thunderer	March 20, 1885	1 350	8	168	9	150
508	Titan	November 7, 1884	19 484	63	309	123	158
519	Shooting Star	August 29, 1883	76 504	324	236	497	154
520	Express	August 29, 1883	86 803	314	276	497	175
1102	Cyclops	July 17, 1884	32 733	183	179	220	149
1104	Sunbeam	July 23, 1884	36 718	157	234	215	170
1111	Messenger	August 11, 1884	31 657	174	182	199	160
1113	Hecate	August 7, 1884	32 625	164	199	202	161
1115	Snake	August 14, 1884	27 818	146	190	196	142
1116	Friar	August 14, 1884	33 625	144	234	196	172
1117	Penguin	August 21, 1884	32 212	170	189	190	170
1120	Apollo	July 10, 1884	37 148	178	209	226	164
2063		May 13, 1884	36 226	218	166	276	131
	Grand Totals and Average		1 869 641	7 998	234	11 362	165

the 5:5 P. M. passenger train from Liverpool to Euston between Liverpool and Crewe, the load consisting of eighteen vehicles weighing 227 tons 15 hundred-weight, or, including the engine and tender, a total load of 292 tons 15 hundred-weight. The journey from Edge Hill to Crewe, a distance of 34¼ miles, was run in forty-five minutes, giving a speed of 43.4 miles per hour, the engine steaming freely throughout the trip."

On June 30th, 1885, the preceding mileage had been increased to 2 226 112 miles, with an average consumption of coal per mile run of 29.01 pounds, of which 1.02 pounds was consumed in starting the fires, leaving 27.99 pounds average consumption of coal per engine mile.

The preceding is a remarkably good showing, both for high average daily mileage during actual running days, and for small consumption of coal.

Mr. T. N. Ely, M. Am. Soc. C. E., General Superintendent of Motive Power of the Pennsylvania Railroad, sends the author the average locomotive mileages given in Table No. 34.

TABLE No. 34.

Statement showing Total Mileage of 48 Standard Passenger Locomotives during the Years 1882, 1883 and 1884, on Pennsylvania Railroad Division.

Mileage.	Mileage.	Mileage.	Mileage.
230 637	151 606	132 234	112 823
220 134	150 057	129 806	109 796
220 120	148 831	128 746	109 516
203 916	148 008	127 387	109 344
184 805	147 009	123 917	108 879
173 850	146 317	120 567	107 820
171 979	145 852	119 155	106 843
170 321	141 126	116 747	106 749
163 052	140 746	115 479	105 903
156 241	136 905	115 443	105 588
152 446	136 850	114 208	105 188
152 014	135 989	113 614	104 661

Total mileage of 48 locomotives, 3 years.....	6 679 224
Average " " "	139 151
" " " per year.....	46 384

Daily average (313 days = 1 year) 131 miles.

The separate mileages of these locomotive are very astonishing, averaging in three years for six days in the week as follows:

First on the above list	251	miles daily.
Second on the above list	240	"
Third on the above list	240	"
First ten on the above list	202	"

Under a recent date, Mr. Ely writes as follows to the author:

"As a matter of information bearing upon the durability of construction of American locomotives, locomotive No. 1047, class 'O,' 18 × 24, with 63" drivers, using bituminous coal, running with passenger trains on the Pittsburgh Division, ran a total of 41 510 miles in three consecutive months last. There are many other locomotives on this road that have made very large mileages, but this is the greatest for so short a period of time."

This average for ninety days of 461 miles daily, speaks well for the American engine, and also for workmanship at the Pennsylvania Railroad shop at Altoona.

The following statement has been furnished to the author by Mr. W. W. Evans, M. Am. Soc. C. E.

(Statistics given to W. W. Evans by Wm. Buchanan, Chief Engineer of Motive Power.)

Statement of Five Years' Service of Locomotives No. 10, No. 33 and No. 34, on the Hudson River Division, New York Central and Hudson River Railroad. These engines were new when they commenced running, and have been used only on through passenger trains.

Cylinders, 17" × 24"; driving wheels, 69"; fire-boxes of steel, flues of semi-steel; weight in running order, 70 500 pounds; weight on driving wheels, 44 850 pounds; average speed, 38 miles per hour; date, from September 30th, 1877, to September 30th, 1882.

Average trains consist of

2 Baggage and mail cars, loaded	52	gross	tons
2 Drawing-room or sleeping cars, loaded	64	"	
5 First-class passenger cars, loaded	125	"	
1 Engine	31 Tons		
1 Tender, half-loaded	22 "		
	53	"	
Total train	294	gross	tons

TABLE No. 35.

	Locomotive No. 10.	Locomotive No. 33.	Locomotive No. 34.	Average of all three.
Total mileage in five years	415 790	440 654	392 043	416 162
Number of days in service	1 495	1 565	1 430	1 496
Number of days idle	306	242	397	315
Actual months in service	59	58	57	58
Average miles run per month	7 047.50	7 597.50	6 878	7 174.27
Average miles run each service day	278.12	281.57	274.15	277
Average miles run per year	83 158	88 131	78 409	83 233
Gallons of oil used	2 882	3 337	3 027	3 082
Average miles run per gallon	144.27	132.05	129.51	135.27
Total cost for oil	$1 182	$1 368	$1 241	$1 264
" " waste	240	232	230	234
" " labor on engine	4 066.64	4 480.24	4 343.90	4 296.93
" " " tender	285.94	447.86	380.07	371.29
" " materials E. & T.	3 218.58	4 167.39	3 621.24	3 669.07
Average cost of labor and materials used in repairs per mile run, in cents	$1\frac{85}{100}$	$2\frac{05}{100}$	$2\frac{15}{100}$	2

The following data has been kindly furnished by Mr. Walter Katte, M. Am. Soc. C. E., Chief Engineer of the New York, West Shore and Buffalo Railway.

"In relation to the comparative speed of both ordinary and extraordinary (or special) trains now attained and in ordinary use on first-class American railways, I beg to offer the following memoranda of what is now being done on the New York, West Shore and Buffalo Railway, which exhibits the details of an extraordinary fast run made on July 9th, 1885, by a special train between Buffalo and Weehawken, a distance of 422.6 miles.

"This train consisted of a locomotive, one baggage car and two official cars, weighing in total between 155 and 156 tons, as follows:

Make-up and weight of train, exclusive of engine—

Tender with two-third load of coal and water	62 800	pounds
Baggage car, West Shore, No. 737	46 030	"
Official car, West Shore, No. 90	61 200	"
Official car, Baltimore and Ohio, No. 711	46 430	"
Total	216 460	"

Add for total weight of train—

On Buffalo Division, West End, Engine No. 45, Class B (bituminous), 94 500 pounds. Total	310 960	pounds
Equal to about	155	tons

On Buffalo Division, East End, Engine No. 50, Class B, 94 500 pounds. Total.....	310 960 pounds
Equal to about.....	155 tons
On Hudson River Division, West End, Engine No 27, Class A (anthracite), 96 000 pounds. Total.....	312 460 pounds
Equal to about.....	156 tons
On Hudson River Division, East End, Engine No. 36, Class B, 94 500 pounds. Total.....	310 960 pounds
Equal to about.....	155 tons

"The train (see Table 36) started from East Buffalo at 10:04 A.M., and reached Weehawken at 7:27 P.M., or 9 hours 23 minutes on the trip, making 19 stops consuming 2 hours, reducing the actual running time to 7 hours 23 minutes, or a general average of about 56 miles per hour running time. This train attained a speed of 87 miles per hour between Churchville and Genesee Junction, on the west end of the Buffalo Division; and at several other places attained speeds from 70 to 80 miles per hour.

"It is interesting to state the fact that this train was run without any preconcerted effort or preparation for it. It was run by four different engines, which were called on to take this 'special' just as they stood in their respective yards waiting to take their 'regular' trains. Nor were the enginemen informed beforehand that they were expected to make more than ordinary speed; they were simply told to see how fast they could run after getting started. The train was run subject to all the exigencies and privileges of the regular trains on the line, none of which were obstructed or interfered with. The several engines, when through with their runs, did not show the slightest signs of having made any extra effort, and were in perfect condition to turn right round and make their runs back again, if it had been desired; neither was the steam pressure greater, nor the amount of fuel consumed greater than allowable or out of proportion to the speed attained.

"Table No. 37 gives the time of nineteen regular passenger trains, running on the present summer schedule, between Weehawken and Buffalo, Syracuse, Schenectady, Albany and Kingston, which shows their average speeds to be from 28 to 37 miles per hour, including stops, and from 33 to 50 miles per hour excluding stops—on regular schedule time. When making up 'lost time,' it is not uncommon for these trains to be run at speeds fully up to 60 miles per hour between stations.

TABLE No. 36.

Summarized Record of Fast Run on the New York, West Shore and Buffalo Railway on July 9, 1885, from East Buffalo to Weehawken, 422.6 Miles. Principal Stations only.

Running Record.				Speed Record.†												
Distance Miles.	Stations.	Time.	Remarks.*	East Buffalo.	Genesee Junction.	Newark.	Syracuse.	Utica.	Frankfort.	Canajoharie.	Rotterdam Junction.	Coeymans.	Kingston.	Cornwall.	Haverstraw.	Weehawken.
0.0	Buffalo															
3.4	East Buffalo	10:04	Took train fron Niagara Falls Branch	....	68	67	64	62	62	60	60	60	58	58	57	57
64.3	Genesee Junction	11:00 11:07	B., N. Y. & P. grade crossing. Took water and oiled	....	....	65	61	59	60	58	58	59	56	56	55	56
96.8	Newark	11:41 11:50	Changed engines	....	....	....	59	57	59	57	57	58	55	55	54	55
147.7	Syracuse	12:48 12:55	Stopped for lunch and took water	....	....	....	....	56	58	56	57	57	55	54	54	55
194.2	Utica	1:54		....	....	....	....	....	73	55	57	58	54	54	53	54
205.1	Frankfort	2:04 2:10	Changed engines	....	....	....	....	....	....	51	55	57	53	53	52	54
235.7	Canajoharie	2:48 2:56	Stopped for water	....	....	....	....	....	....	....	60	60	54	54	53	54
266.5	Rotterdam Junction	3:29 3:29	Stopped by block	....	....	....	....	....	....	....	....	61	52	51	51	53
297.8	Coeymans	4:07 4:13	Changed engines	....	....	....	....	....	....	....	....	....	46	50	49	52
337.8	Kingston	5:01 5:01	Grade crossing	....	....	....	....	....	....	....	....	....	....	54	51	55
373.7	Cornwall	6:20		....	....	....	....	....	....	....	....	....	....	....	46	55
392.8	Haverstraw	6:50 6:51	Stopped by block	....	....	....	....	....	....	....	....	....	....	....	....	62
426.0	Weehawken	7:27														

* In addition to the stops noted in this column, the following were made: Red Creek, 11:11 to 11:11, grade crossing; Lyons, held 2 minutes by freight; Clark's Mills, 1:41 to 1:41, grade crossing; So. Schenectady, 3:39 to 3:40, grade crossing; Voorheesville, 3:52 to 3:52, grade crossing; Glenerie, stopped 3 minutes for water; Marlborough, 5:30 to 5:39, stopped by block; Newburgh, 5:59 to 6:00, stopped by block; New Durham, 7:23 to 7:23, stopped by block.

† Speed is given in nearest even miles per hour deducting actual stops, plus two minutes per stop for losing and gaining headway.

TABLE No. 37.

Speed Table New York, West Shore and Buffalo Railway.—Time Table No. 11, July 2d, 1885.

Train No.	Miles Run.	Between Weehawken and	Time.			Stops.			Actual Time Running.	Average Miles Per Hour.	
			Leave.	Arrive.	Consumed.	Station.	Junction.	Time Lost.		Including Stops.	Excluding Stops.
					H. M.			H. M.	H. M.		
59	422.6	Buffalo	7:40	9:50	14 10	93	6	5 40	8 30	29.83	49.71
63	152.6	South Schenectady	9:20	1:30	4 10	4	1	25	3 45	36.62	40.69
51	422.6	Buffalo	10:30	11:55	13 25	16	7	2 03	11 22	31.45	37.17
69	88.2	Kingston	11:35	2:10	2 35	5	0	16	2 19	34.14	38.07
53	278.3	Syracuse	11:45	8:55	9 10	46	5	2 57	6 13	30.36	44.76
67	152.6	South Schenectady	4:05	8:10	4 05	4	1	25	3 40	37.37	41.61
65	141.3	Albany	4:15	9:05	4 50	26	1	1 32	3 18	29.23	42.81
57	422.6	Buffalo	6:30	6:00	11 30	8	7	1 19	10 11	36.74	41.49
55	422.6	"	8:30	11:40	15 10	19	7	2 18	12 52	27.86	32.84
62	422.6	"	3:40	6:30	14 50	46	6	3 22	11 28	28.48	36.83
54	422.6	"	4:50	7:00	14 10	11	7	1 23	12 47	29.83	33.05
66	141.3	Albany	4:10	9:05	4 55	27	1	1 35	3 20	28.73	42.39
52	422.6	Buffalo	9:20	10:20	13 00	16	7	1 53	11 17	32.50	37.45
56	278.3	Syracuse	5:00	2:40	9 40	50	3	3 08	6 32	28.78	42.59
64	152.6	South Schenectady	1:35	6:00	4 25	6	1	32	3 53	34.55	39.29
60	422.6	Buffalo	5:10	7:00	13 50	68	6	4 27	9 23	30.54	45.03
70	88.2	Kingston	5:35	8:00	2 25	4	0	13	2 12	36.49	40.09
68	152.6	South Schenectady	5:13	9:20	4 7	5	1	28	3 39	37.06	41.80
58	422.6	Buffalo	9:30	9:50	12 20	14	6	1 53	10 27	34.26	40.44

"The character of the engines doing this service, with data of their dimensions, weights, etc., is as follows:

General dimensions, weights, etc., of locomotives. Class A (anthracite) and B (bituminous):

Cylinders—	
Diameter and stroke	18 x 24 inches
Ports—length	16 "
Steam port—width	1½ "
Exhaust port—width	3¼ "
Valves: Allen Richardson—	
Travel (maximum)	5½ "
Outside lap	1 "
Inside lap	1/16 "
Lead in full gear	1/32 "
Exhaust nozzles: high double—	
Diameter	3⅛ "
Height from base of stack	18 "
Boiler pressure per square inch	140 pounds
Smoke-stack—Height above rail	14 ft. 5½ inches
Diameter at top	20½ "
Diameter at base	18 "
Smallest internal diameter	15 "
Engine and tender truck wheels: Allen paper.	
Capacity of tender—	
Coal	15,000 pounds
Water	3,000 gallons
Boiler—	
Diameter of smallest ring	55 inches
Length of barrel	10 ft. 11 "
Tubes—	
Number	188
External diameter	2 inches
Length between sheets	10 ft. 10⅝ "
Area through	3.17 square feet

Heating surface—

Tubes	1,084 square feet
Fire-box	128 "
Total	1,212 "

Firebox—

	Class A.	Class B.
Length outside	10 ft., 9 inches	6 ft., 7 inches
Width outside	48 "	41¾ "
Depth inside front	49¾ "	74¾ "
Size of grate	120¾ x 40½ "	70⅜ x 34½ "
Grate area	34 square feet	17 square feet
Weight of engine in working order	96,000 pounds	94,500 pounds
" " on truck	32,000 "	32,000 "
" " on drivers	64,000 "	62,500 "
" tender loaded	76,000 "	76,000 "
" " empty	36,400 "	36,400 "
Maximum weight, engine and tender	172,000 "	170,500 "
Average " " " "	154,000 "	154,000 "

"Their trains vary from four to twelve cars, and often have on one train three baggage and express cars, and three or four Pullman parlor and sleeping cars.

TABLE No. 38.

Physical Characteristics of West Shore Road.

Elements.		Buffalo Division.		Hudson River Division.		Entire Line.
		West End.	East End.	West End.	East End.	
Profile.						
Level	Percentages.	16.93	27.03	29.94	42.18	30.18
Up grade (going East)	Percentages.	45.59	37.50	29.59	30.41	35.62
Down " " "	Percentages.	37.48	35.47	40.47	27.41	34.20
Up grade (going East)	Average feet per mile.	16.25	15.88	16.36	16.96	16.32
Down " " "	Average feet per mile.	18.75	18.49	17.66	22.77	19.51
Alignment.						
Tangents	Percentages	82.52	83.44	73.85	84.26	82.06
Curves	Percentages	17.48	16.56	26.15	15.74	17.94
Curvature, average, degrees		1° 20′ 57″	1° 46′ 11″	2° 04′ 40″	1° 48′ 17″	1° 46′ 34″

"It will be seen by inspecting the above table of the physical characteristics of the road, that it is unusually (for the Eastern States) favorable for making fast time with small effort, its grades over the entire line averaging only 16½ feet per mile rising east, and 19.5 feet per mile going west, while the percentage of grade to level line is 70 per cent. of gradients to 30 per cent. of level—the upward and downward gradients being about equal, or 35 per cent. each; so that a train running in either direction always has the advantage of 30 per cent. of level and 35 per cent. of down grades in its favor.

"The percentage of straight line to curves is also remarkably high, being 82 per cent. straight to 18 per cent. curve. The average degree of curvature over the entire line is about 1¾ degrees, the standard maximum permanent curvature being 4 degrees.

"The road bed and bridges are of thoroughly first-class character; the track is double and laid on the break-joint-system, with 67 pound steel rails on cross-ties averaging 2 800 to the mile; the joints are made with rolled-iron double 'angle splice' bars, weighing 44 pounds per pair, and are 36 inches in length, with three cross-ties under the joints covering the whole length of the splice bars; the track is well ballasted throughout, generally with good gravel, with a considerable proportion of machine-crushed stone ballast."

Endurance of Locomotives.

In order to compare the endurance of the locomotives of the two countries, Table No. 39 was constructed. For the English railroads the data were taken from the Board of Trade Reports; for the American, from the Reports of the Railroad Commissioners of Massachusetts, Reports of the Companies and Poor's Manual.

For the English railroads the average mileage is very uniform, being from 60 to 70 miles daily for 313 days in the year.

The American railroads do not show such uniform results, the mileage being on the smaller Massachusetts railroads about 60 miles; on the Pennsylvania and New York Central, 80 miles; and on the New York, New Haven and Hartford, 96 miles. The last is a remarkable record of locomotive endurance or durability, especially as it was the same for the two previous years.

TABLE No. 39.

Showing the Average Annual Revenue Mileage made by all the Locomotives in 1884 on all the Principal Railroads of the United Kingdom and some of the Principal Railroads of the United States.

Name of Railroad.	Total Number of Locomotives.	Mileage.	
		Total.	Average.
United Kingdom.			
Great Eastern	655	14 053 700	21 458
Great Northern	789	16 978 030	21 498
Great Western	1 577	30 457 257	19 314
London and North Western	2 476	38 184 328	15 422
London and South Western	501	11 183 874	22 323
London, Brighton and South Coast	410	8 136 077	19 844
London, Chatham and Dover	180	3 889 988	21 611
Midland	1 697	33 261 729	19 600
North Eastern	1 470	23 873 903	16 241
Caledonian	690	12 489 848	18 101
North British	585	11 676 275	19 958
Great Northern of Ireland	127	2 636 570	20 760
Great Southern and Western of Ireland	163	2 913 669	17 874
Totals and Average	11 320	209 735 248	18 528
United States.			
Pennsylvania:			
Pennsylvania Railroad Division	815	20 791 778	25 511
United Railroads of New Jersey Division	335	8 408 926	25 101
Philadelphia and Erie Division	110	2 353 131	21 392
Baltimore and Ohio	603	11 405 777	18 915
New York Central and Hudson River	657	16 452 835	25 043
New York, Lake Erie and Western	805	17 092 582	21 233
Boston and Albany	243	4 960 185	20 407
Fitchburg	100	1 986 319	19 863
Boston and Lowell	147	1 915 312	13 028
Boston and Maine	92	1 829 573	19 887
Eastern	115	2 142 225	18 628
Boston and Providence	57	973 646	17 081
New York and New England	147	2 350 058	15 986
Old Colony	125	2 428 954	19 432
New York, New Haven and Hartford	128	3 827 685	29 904
Totals and Average	4 479	98 918 986	22 085

Locomotive Earnings.

In order to ascertain the money-earning qualities of the locomotives of each country, Table No. 40 was constructed, in which fourteen railroads, embracing all the principal roads of the United Kingdom, are compared with an equal number of American roads.

TABLE No. 40.

Showing the Average Annual Earnings of Locomotives on Different Railroads in 1883.

Name of Railroad.	Total Number Locomotives.	Earnings from Traffic.	
		Total.	Average per Locomotive.
United Kingdom.			
Great Eastern	615	£3 279 354	£5 330
Great Northern	733	3 522 035	4 805
Great Western	1 577	7 817 742	4 957
London and North Western	2 451	10 362 520	4 228
London and South Western	471	2 797 550	5 940
London, Brighton and South Coast	410	2 114 879	5 158
London, Chatham and Dover	168	1 095 317	6 520
Midland	1 629	7 363 217	4 520
North Eastern	1 462	6 699 891	4 583
South Eastern	325	1 949 391	6 000
Caledonian	690	2 923 890	4 237
North British	573	2 611 803	4 558
Glasgow and South Western	290	1 111 796	3 834
Great Southern and Western of Ireland	160	753 396	4 709
Totals and Average	11 554	£54 402 781	£4 709
United States.			
Pennsylvania—Pennsylvania Division	795	$32 017 813	$40 273
Do. United Railroads of New Jersey	330	14 408 540	43 662
Do. Philadelphia and Erie	110	4 108 843	37 353
New York, Lake Erie and Western	785	22 040 595	28 077
New York Central and Hudson River	655	29 359 745	44 824
Boston and Albany	244	8 103 957	33 213
Fitchburg	98	2 825 024	28 827
Boston and Lowell	77	2 102 887	27 310
Boston and Maine	89	2 915 944	32 763
Eastern	109	3 417 267	31 351
Boston and Providence	53	1 646 962	31 075
New York and New England	151	3 376 311	22 360
Old Colony	120	4 158 977	34 658
New York, New Haven and Hartford	122	6 650 549	54 513
Totals and Average	3 738	$137 133 414	$36 686

Notwithstanding that the average charges, both for passengers and freight, are much lower in the United States than in the United Kingdom, the average earnings of the locomotives on the above fourteen American railroads are 55 per cent. greater than the average of the fourteen roads of the latter country as named above. This speaks well for the money-making quality of the American locomotive, as well as for its durability.

The London and North Western Railway has about the same amount of traffic-earnings as the three divisions of the Pennsylvania Railroad

named (the other divisions have been excluded, as being in the level Western States), yet the latter company only has about half the number of locomotives, notwithstanding this road has very heavy grades, and with one summit 2 154 feet above the sea.

Relation between Train Load and Charges.

Table No. 41, compiled from the Reports of the New York Central and Hudson River Railroad, shows the cost of transporting a ton of freight for 14 years—from 1870 to 1883, inclusive—and also the average load of freight trains for each year. It will be noticed that the average earnings or charges per ton per mile have decreased one-half, and the average loads of freight trains have doubled within the 14 years.

TABLE No. 41.

Freight Earnings, Expenses and Profit per Ton-mile, and per Train-mile, and average Train-load.

Year Ending September 30th.	Earnings per ton-mile on freight.	Expenses per ton-mile on freight.	Profit per ton-mile on freight.	Earnings per train-mile on freight.	Expenses per train-mile on freight.	Profit per train-mile on freight.	Average number of tons of freight in train-load.
	Cents.	Cents.	Cents.				
1870	1.88	1.15	0.73	$1.95	$1.19	$0.76	103
1871	1.62	1.01	0.61	2.07	1.28	0.79	127
1872	1.59	1.12	0.47	2.05	1.45	0.60	129
1873	1.57	1.02	0.55	2.02	1.32	0.70	129
1874	1.46	0.98	0.48	2.03	1.37	0.66	139
1875	1.27	0.90	0.37	2.11	1.49	0.62	166
1876	1.05	0.71	0.34	1.89	1.28	0.61	180
1877	1.01	0.69	0.32	1.68	1.15	0.53	166
1878	0.93	0.59	0.34	1.71	1.10	0.61	183
1879	0.78	0.54	0.24	1.52	1.05	0.47	191
1880	0.87	0.54	0.33	1.92	1.18	0.74	218
1881	0.78	0.56	0.22	1.70	1.23	0.47	217
1882	0.73	0.60	0.13	1.62	1.31	0.31	219
1883	0.91	0.68	0.23	1.82	1.37	0.45	199

A similarly constructed table for the Pennsylvania Railroad shows that, within the last 20 years, the average freight charges have been reduced two-thirds, while the average load of freight trains has been more than doubled.

The workings of other American railroads also show the great economy in running heavy freight trains.

The English roads, on account of their good alignment and easy

grades, ought to be able to run heavier freight trains than the American, with proportionate saving in cost; this would enable them to reduce their charges, or pay larger dividends.

Other causes have contributed to this reduction in the cost of transportation, besides the increased load of freight trains; this, however, must have great influence on the result, as now one engine and one set of men do more work than two engines and two sets of men did formerly.

The author has been desirous to compare impartially and closely the operating expenses of the railroads of the United Kingdom and those of the United States—the result of comparing the cost of motive power on the two systems has been as great a surprise to him as it will be to any one.

At the very outset he was met with the apparently insurmountable obstacle that the English do not keep any accounts showing the passenger or ton mileage, which is so necessary for comparing operating expenses. After diligent investigation and research, he made his rules for estimating and supplying this deficiency (see page 16). Of course these are only his views and analysis of the data available to him, which he is willing to change promptly by any reliable or official data. He hopes that the railroads which are so largely interested in this question, will promptly replace his estimates by their official figures. Until this is done, he claims that these figures should be accepted as correct.

In conclusion, the author begs the indulgence of his readers for the imperfection of this paper. The data was collected, compiled and analyzed while he was very closely occupied in other professional duties. He is aware that the arrangement of many of the tables could be much improved and others advantageously made, but he cannot do this, for the want of the necessary time. Doubtless, many clerical errors will be discovered, as for want of time many calculations have not been checked.

All who are interested in this line of study can, from the data here given, make their own tables and draw their own conclusions, as the author has done.

Conclusions.

In the opinion of the author, neither the English or American railroad is perfect in itself, if the object of a railroad is to give the greatest amount of comfort to the passengers for the least amount of money, and the cheapest freight charge to the shipper. In this light the Pennsylvania Railroad comes nearer perfection than any other, but it has the serious fault of many level road-crossings. All other large American railroads have, in addition to this defect, that of the absence of the block system. With these two faults alone, they are far from being perfect, to say nothing of minor improvements required, such as good station buildings, etc.

Although the English cars are far from being as comfortable for travelers as the American, yet the English engineer can do but little now to remedy it, owing to the low and narrow cars he is obliged to run. Perhaps the most that could be done would be economising in the cost of motive power, the general introduction and use of the American baggage check on all connecting lines, thereby increasing the comfort of passengers, and also saving a large expense to the railroads in saving the cost of many unnecessary porters; warming the cars in winter; general use of the bogie truck under passenger cars, thereby diminishing the constant jarring motion now so great in them.

The English road-bed, superstructure and block signaling system is all that could be desired.

From superficial observation, it is difficult to say what is the cause of the great additional cost in motive power in operating the English railroads, when it should be much less than that of the American railroads, as, owing to their average superior construction, with easier grades and curves, it should not be much over half, instead of being nearly double.

Apparently the most prominent cause of this increased cost is the great speed and small tonnage of the freight trains, and too many passenger trains lightly loaded.

Perhaps the American bogie-truck rolling stock runs with less friction than the rigid wheel-base rolling stock used on the English roads.

The English railroads have cost per mile more than three times as much as the American, yet they only save eight per cent. of the annual operating expenses. In other words, to save one-twelfth of the annual

operating expenses the cost of construction has been increased more than three times. The preceding comparison would be still more striking if we brought into calculation the comparative cost in the two countries of the different items included under the heading of "Maintenance of way," "Locomotive Charges" and "Repairs of Carriages." Probably 90 per cent. of these are made up of labor, fuel, iron, steel, etc., all of which would average, in 1883, fully one-fourth higher in the United States than in the United Kingdom. This speaks very well for the American system, that, notwithstanding it costs much less to construct, after paying higher prices for labor and materials—and for financial reasons the location is often faulty, and the superstructure of perishable materials—yet it is operated for less than the English roads are, when due allowance is made for the difference in the price of labor and materials that enter into operating expenses. Notwithstanding these disadvantages, for similar accommodation, the passenger rates and freight charges are much less on American than on English railroads.

One of the principal items of the greater cost of English railroad construction over the American, is the necessity of having much straighter alignment or easier curves, so that it can be safely operated by the rigid and long wheel-base rolling stock in use there.

The Baltimore and Ohio Railroad is a sample of what can be done with the American rolling stock. This road is built through a very difficult and rugged country, which compelled a very poor alignment, with nearly one-half of the entire length in curvature, which curves run up to 600 feet radii, and long grades running up to 120 feet per mile. The country affords no natural advantages whatever. Yet, with all these drawbacks, this road does a very large and profitable business, paying annually ten per cent. dividend, and running passenger trains safely at very high speed.

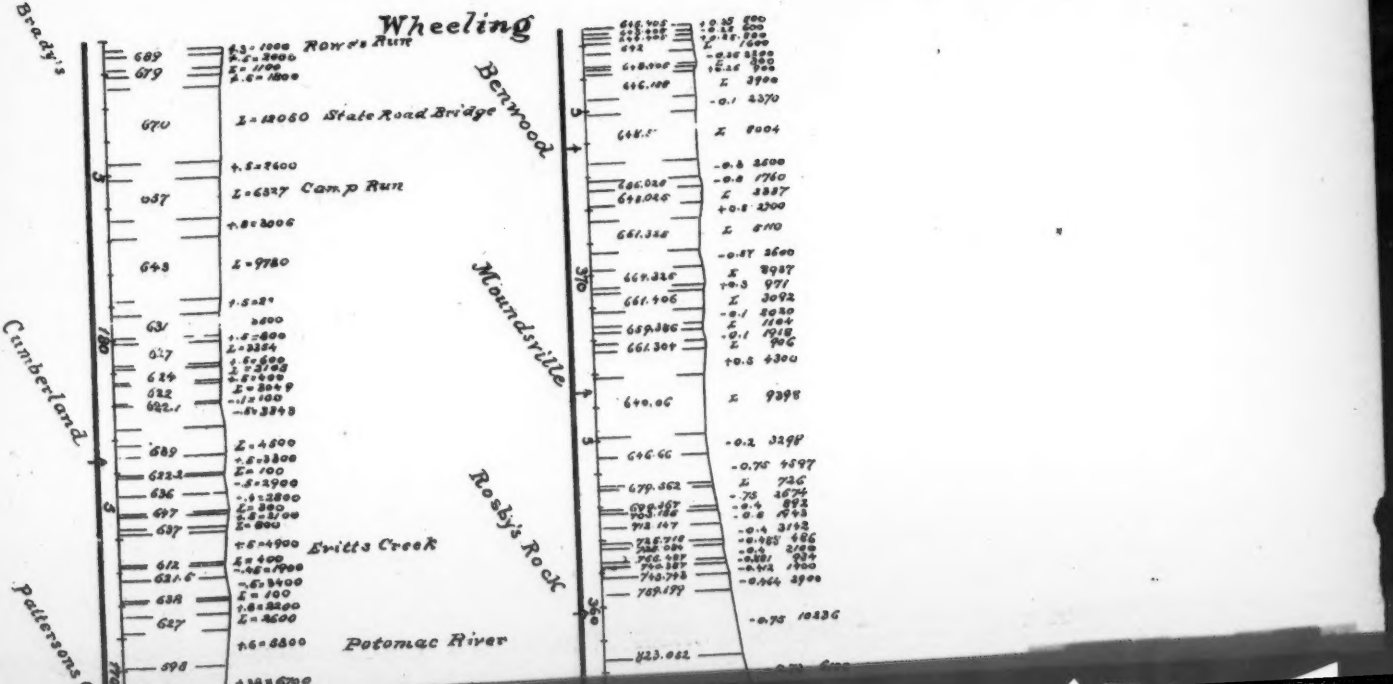
All this is done on a road that could not be operated with rolling stock built on the English system. The extra cost of enlarging these curves to adapt them to English rolling stock would be so great as to be commercially impracticable. It is not difficult to appreciate the great difference in cost of construction, in an extremely rough country, of a railroad with curves 600 feet, or 2 640 feet radii.

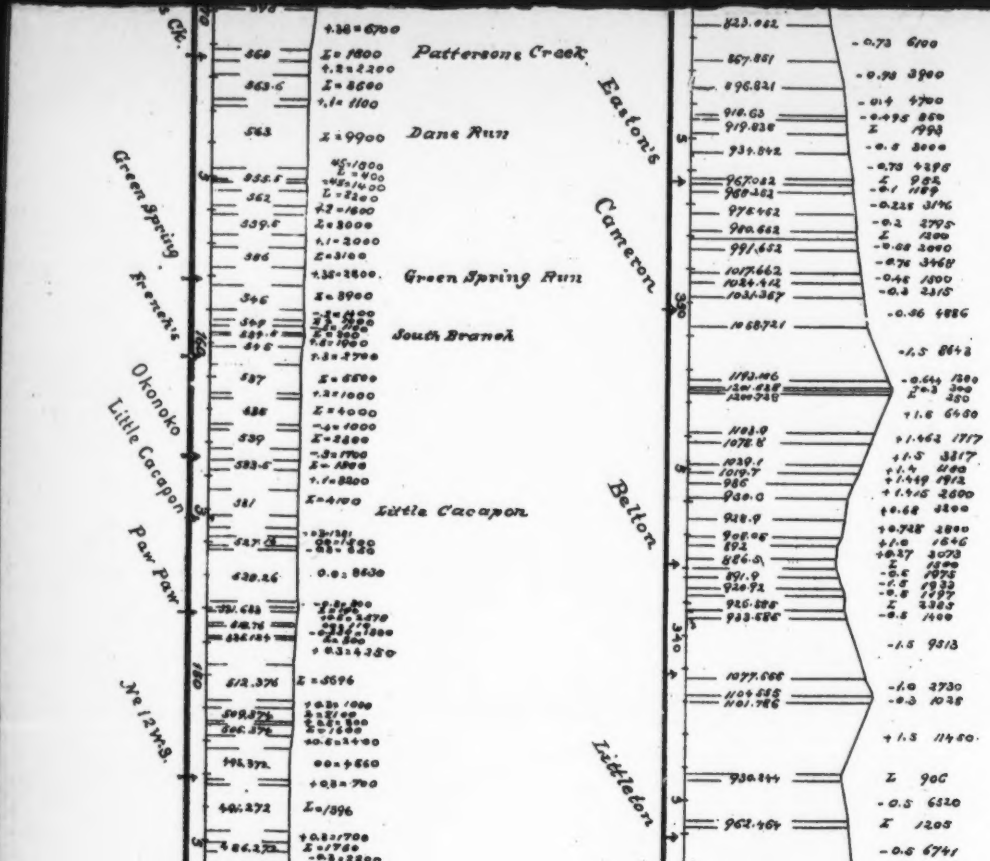
Unquestionably the American system of construction is the best for new countries, or where cheapness of construction is desirable. The American rolling stock, with the bogie truck, will run safely and rapidly

over roads of inferior construction, or sharp curves that would be impossible for rolling stock constructed on the English type of long and rigid wheel base. The American type is especially adapted for military purposes. During the late American war some military railroads were operated successfully, with the ordinary American rolling stock, with curves of 50 feet radius. The New York Elevated Railroad has been operated for years (it transported last year 97 000 000 passengers) without accident, and has many curves under 100 feet radius. Through an ordinary rough country, a railroad to be operated with the American type of rolling stock could be constructed in one-fourth of the time and for one-fourth of the money that one suitable for the English rolling stock could be built.

It would certainly pay the management of the English railroad companies to investigate the cause of the extra cost of motive power on their roads, and, if possible, remedy it. If this can be done, they will be able to *decrease their operating expenses* over 8 per cent., without making any changes whatever in the present prices. This will enable most companies to *increase their dividends* largely—probably over 4 per cent.

For what *is* done in the United States *ought* to be done in the United Kingdom.


Wheeling
Brady's
Cumberland
Patterson's
Bentwood
Moundsville
Rosby's Rock
Potomac River
Row's Run
State Road Bridge
Camp Run
Evitt's Creek


Patterson Creek
Dane Run
Green Spring Run
South Branch
Little Cacapon
Green Spring
Frenchs
Okonoko
Little Cacapon
Paw Paw
No 12 W.S.
Easton's
Cameron
Belton
Littleton

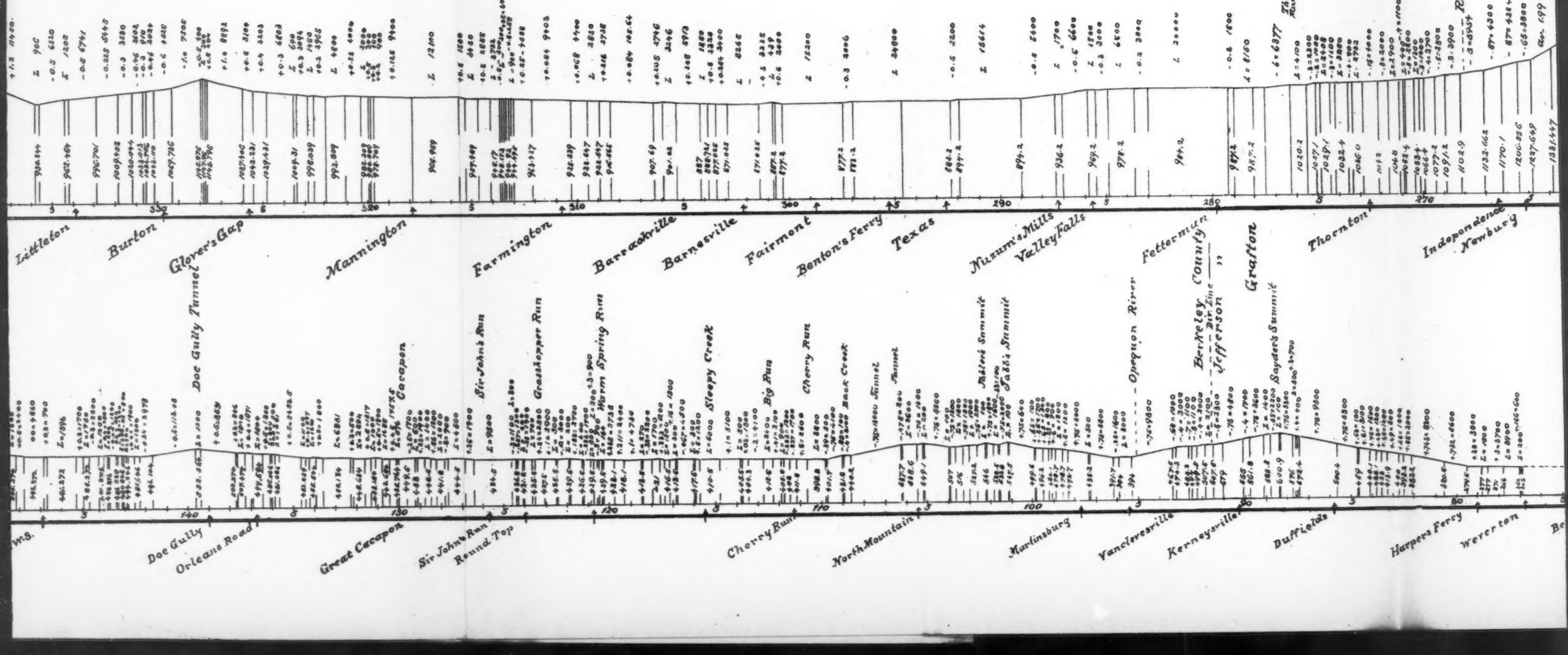
PROFILE OF THE BALT

BALTIMORE

PROFILE OF THE BALTIMORE AND OHIO RAILROAD

FROM

BALTIMORE TO WHEELING



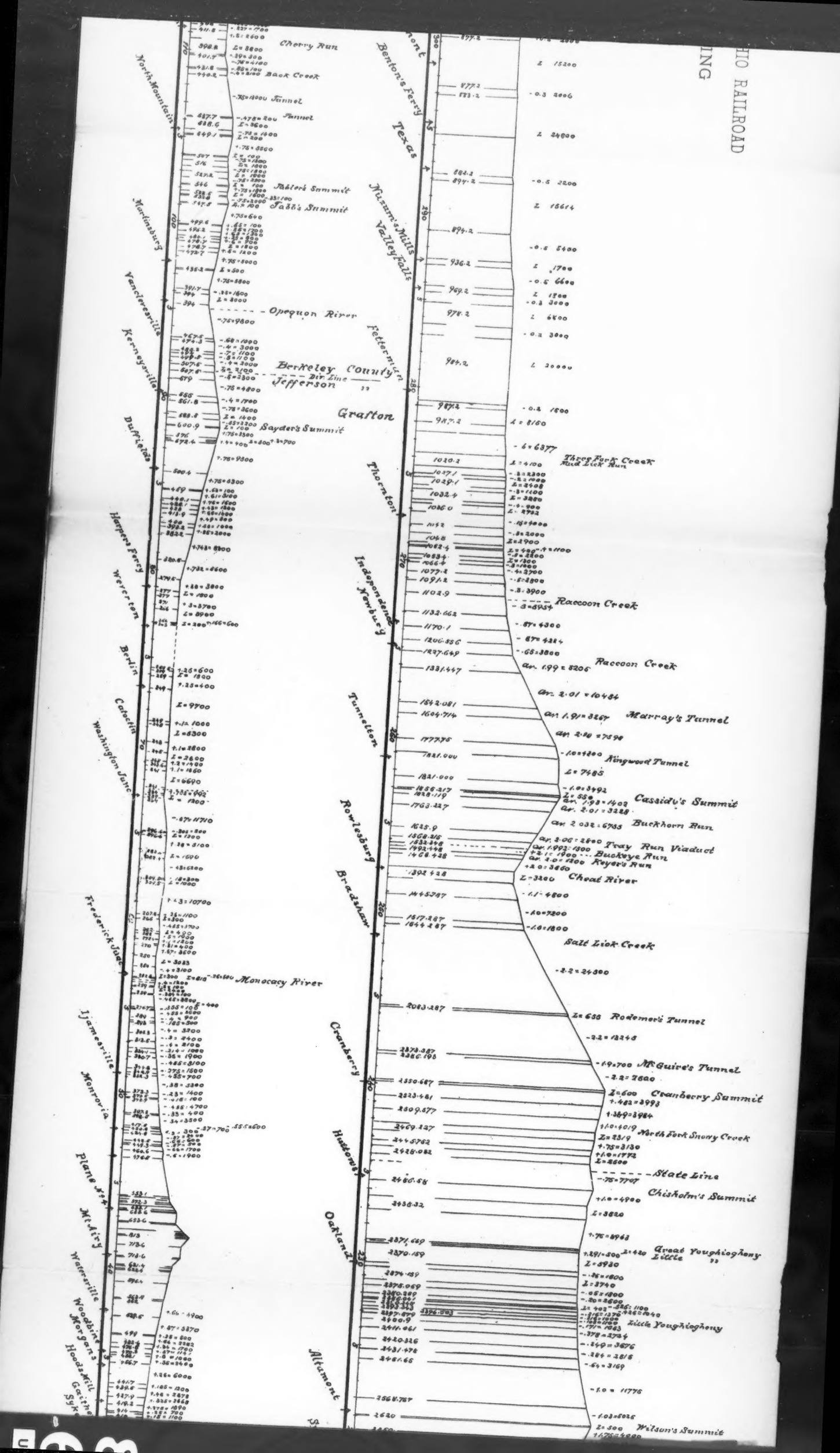
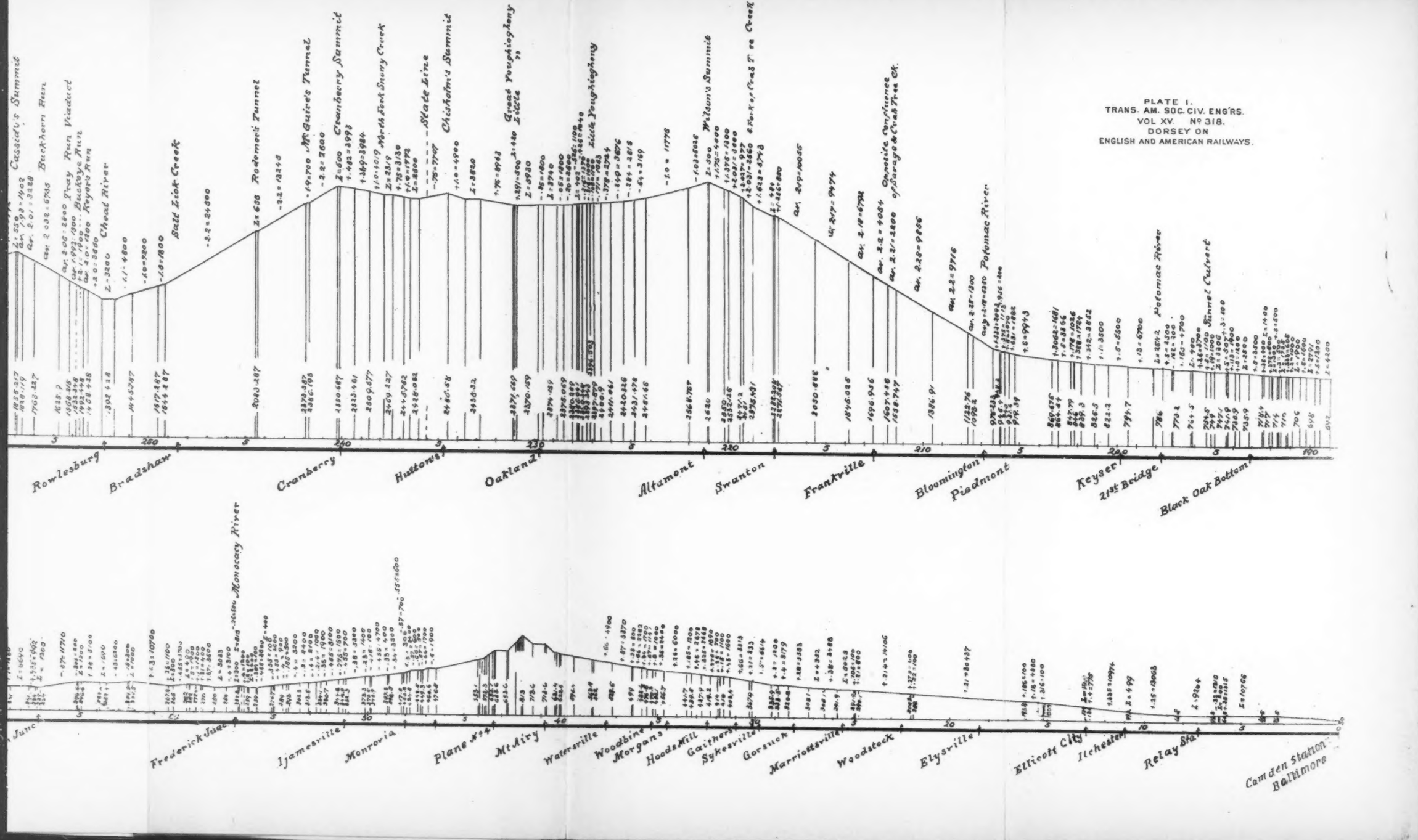

Cherry Run
Back Creek
Tunnel
Tunnel
Fabler's Summit
Fabb's Summit
Opequon River
Berkeley County
Dir. Line
Jefferson
Grafton
Sayder's Summit
Harpers Ferry
Berlin
Catoctin
Washington Junc.
Monocacy River
Ijamsville
Monrovia
Plane No 4
Mt Airy
Waterville
Woodbine
Morgans
Hoods Mill
Gaithe
Sykesville
North Mountain
Martinsburg
Vanclevesville
Kennersville
Duffields
Weverton
Frederick Junc.
Benton's Ferry
Texas
Muzzm's Mills
Valley Falls
Fetterman
Thornton
Independence
Fenwbury
Tunnelton
Rowlesburg
Bradshaw
Cranberry
Hutchons
Oakland
Altamont
Raccoon Creek
Raccoon Creek
Murray's Tunnel
Ringwood Tunnel
Cassidy's Summit
Buckhorn Run
Tray Run Viaduct
Buckeye Run
Reyer's Run
Cheat River
Salt Lick Creek
Rodemer's Tunnel
McGuire's Tunnel
Cranberry Summit
North Fork Snowy Creek
State Line
Chisholm's Summit
Great Youghiogheny
Little
Little Youghiogheny
Wilson's Summit
Three Fork Creek
Mud Lick Run
HIO RAILROAD
ING

PLATE I.
TRANS. AM. SOC. CIV. ENG'RS.
VOL XV. Nº 318.
DORSEY ON
ENGLISH AND AMERICAN RAILWAYS.



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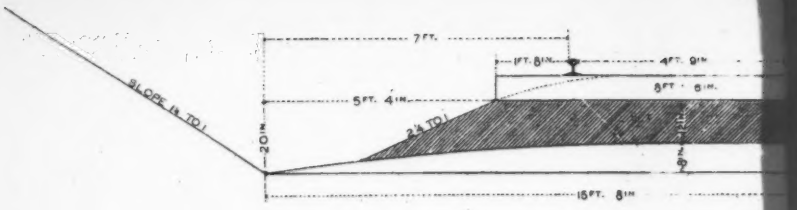
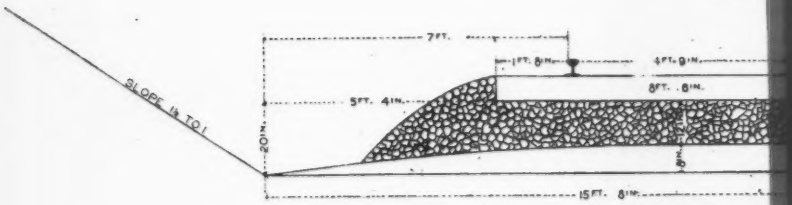
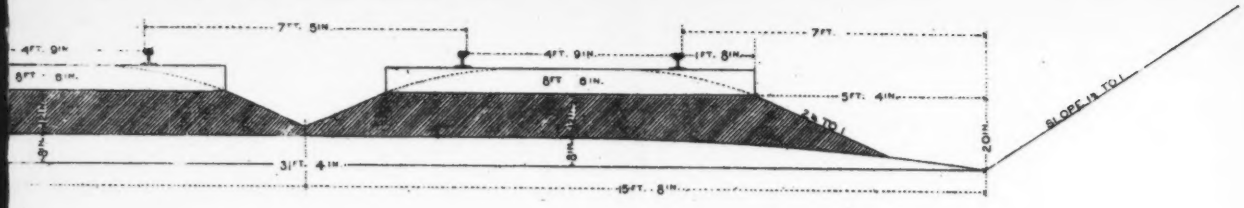

SLOPE IS TO 1
7FT.
1FT. 8IN.
4FT. 9IN.
8FT. 8IN.
5FT. 4IN.
20IN.
2½ TO 1
8IN.
15FT. 8IN.

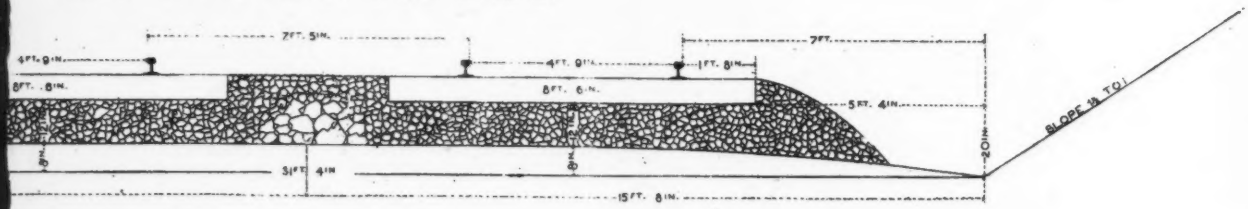
CROSS

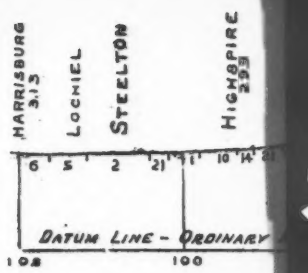

SLOPE IS TO 1
7FT.
1FT. 8IN.
4FT. 9IN.
8FT. 8IN.
5FT. 4IN.
20IN.
8IN.
15FT. 8IN.

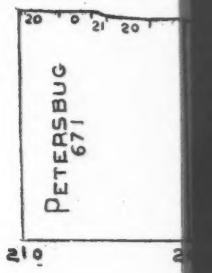
CROSS SECTION GRAVEL BALLAST



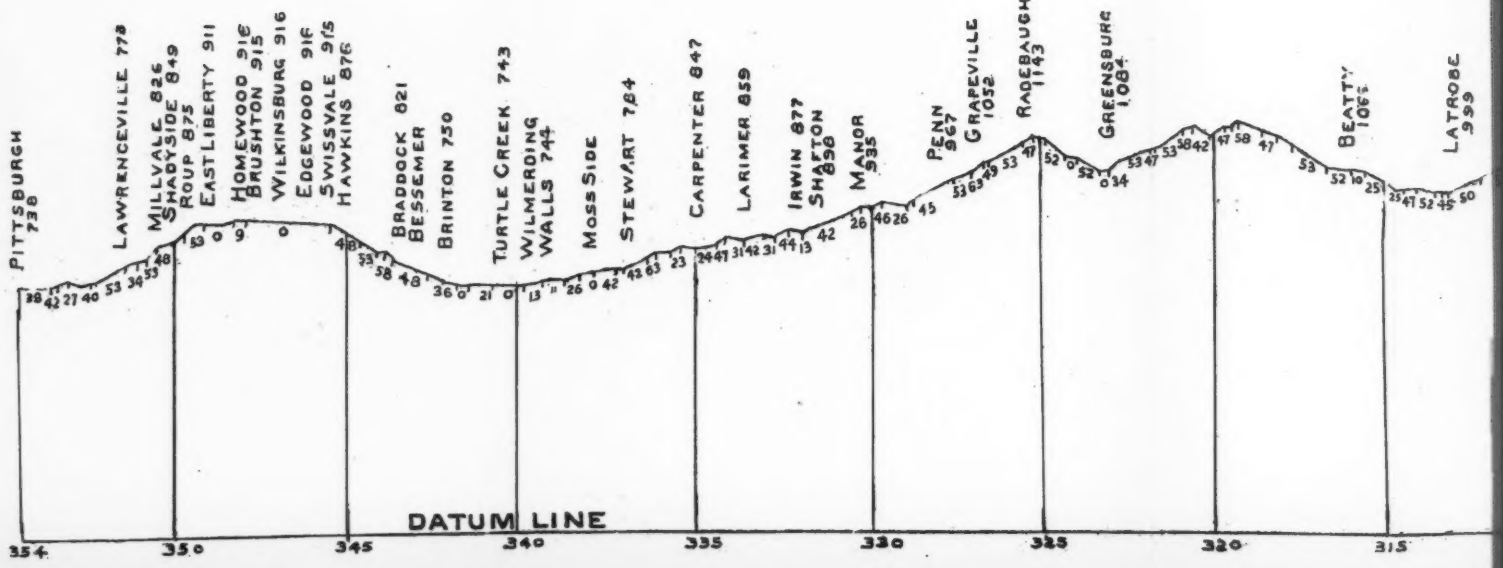
CROSS SECTION BROKEN STONE BALLAST

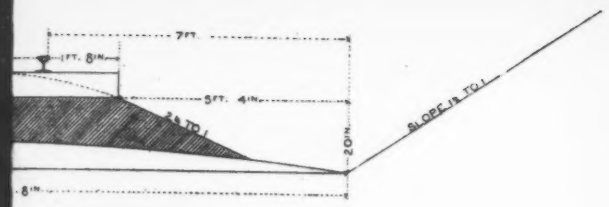


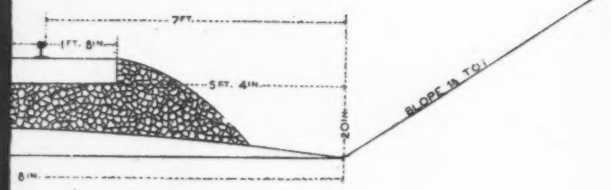


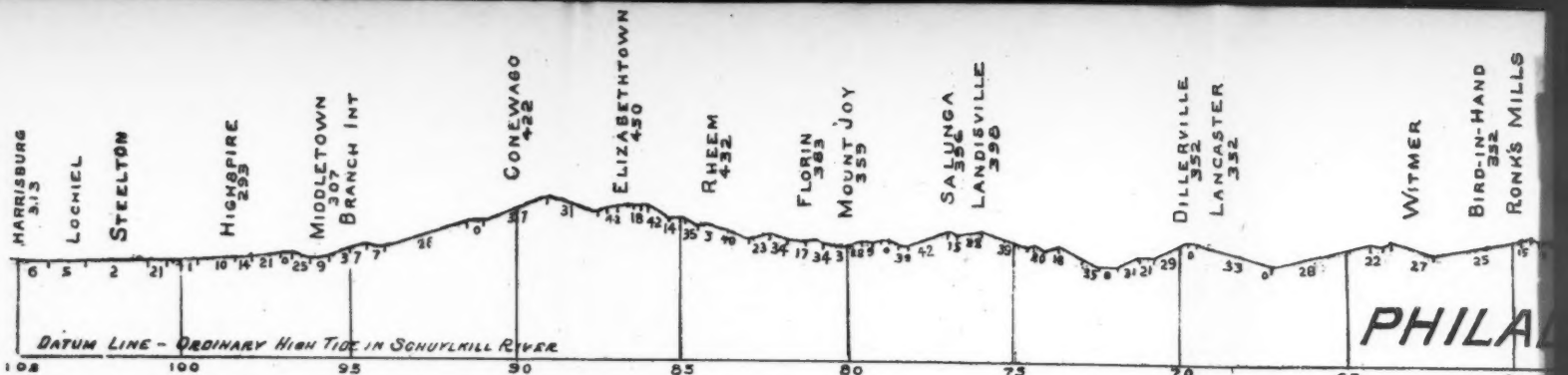


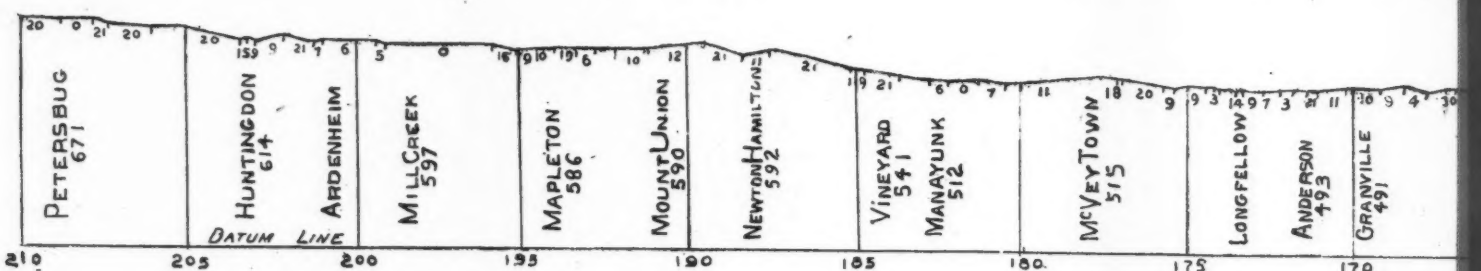
PITTSBURGH



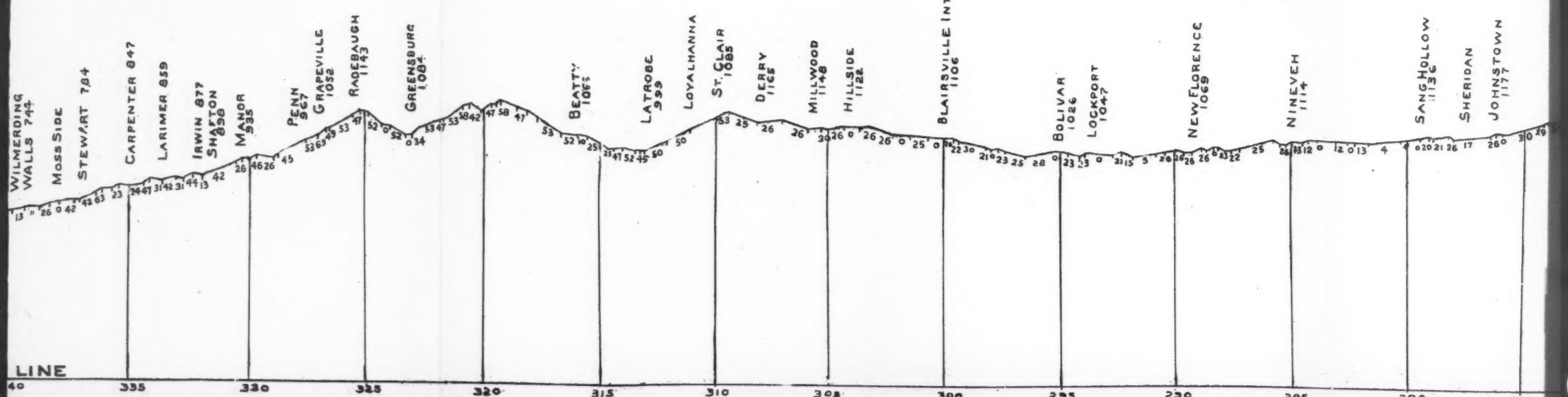


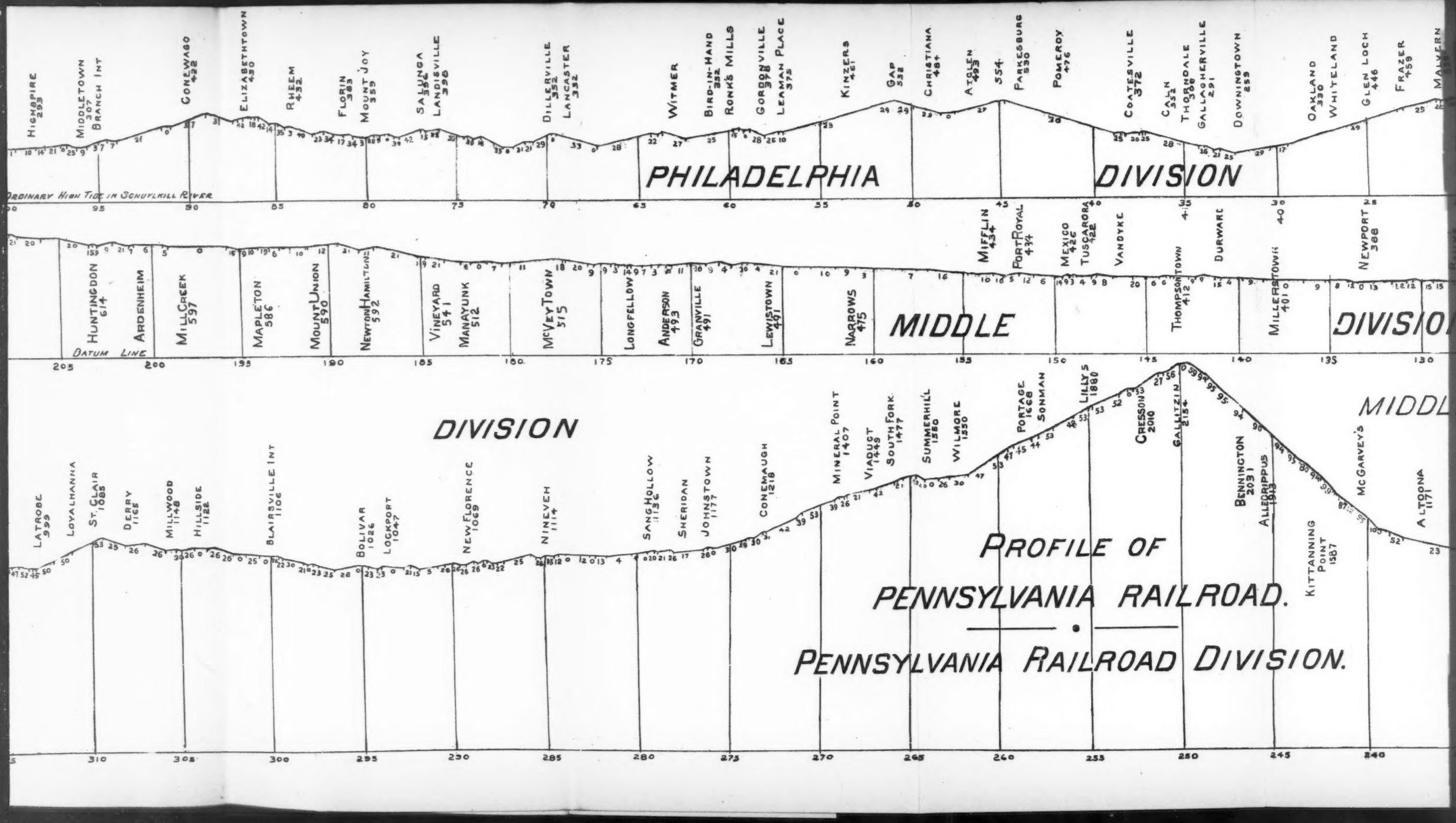






PITTSBURGH DIVISION




PHILADELPHIA DIVISION
MIDDLE DIVISION
PROFILE OF
PENNSYLVANIA RAILROAD.
PENNSYLVANIA RAILROAD DIVISION.
ORDINARY HIGH TIDE IN SCHUYLKILL RIVER
DATUM LINE
HIGHSPIRE 293
MIDDLETOWN 307
BRANCH INT
CONEWAGO 422
ELIZABETHTOWN 430
RHEEM 432
FLORIN 383
MOUNT JOY 359
SALUNGA 356
LANDISVILLE 396
DILLERVILLE 352
LANCASTER 332
WITMER
BIRD-IN-HAND 382
RONKS MILLS
GORDONVILLE 378
LEAMAN PLACE 375
KINZERS 461
GAP 532
CHRISTIANA 484
ATGLEN 493
554
PARKESBURG 530
POMEROY 476
COATESVILLE 372
CALN 352
THORNDALE 386
GALLAGHERVILLE 291
DOWNINGTOWN 259
OAKLAND 330
WHITELAND
GLEN LOCH 446
FRAZER 459
MALVERN
HUNTINGDON 614
ARDENHEIM
MILL CREEK 597
MAPLETON 586
MOUNT UNION 590
NEWTON HAMILTON 592
VINEYARD 541
MANAYUNK 512
MCVEYTOWN 515
LONGFELLOW
ANDERSON 493
GRANVILLE 491
LEWISTOWN 491
NARROWS 475
MIFFLIN 434
PORT ROYAL 434
MEXICO 426
TUSCARORA 422
VANDYKE
THOMPSONTOWN 412
DURWART
MILLERSTOWN 401
NEWPORT 388
LATROBE 999
LOYALHANNA
ST. CLAIR 1085
DERRY 1165
MILLWOOD 1148
HILLSIDE 1122
BLAIRSVILLE INT 1106
BOLIVAR 1026
LOCKPORT 1047
NEW FLORENCE 1069
NINEVEH 1114
SANG HOLLOW 1136
SHERIDAN
JOHNSTOWN 1177
CONEMAUGH 1218
MINERAL POINT 1407
VIADUCT 1449
SOUTH FORK 1477
SUMMERHILL 1560
WILMORE 1350
PORTAGE 1668
SONMAN
LILLY'S 1880
CRESSON 2010
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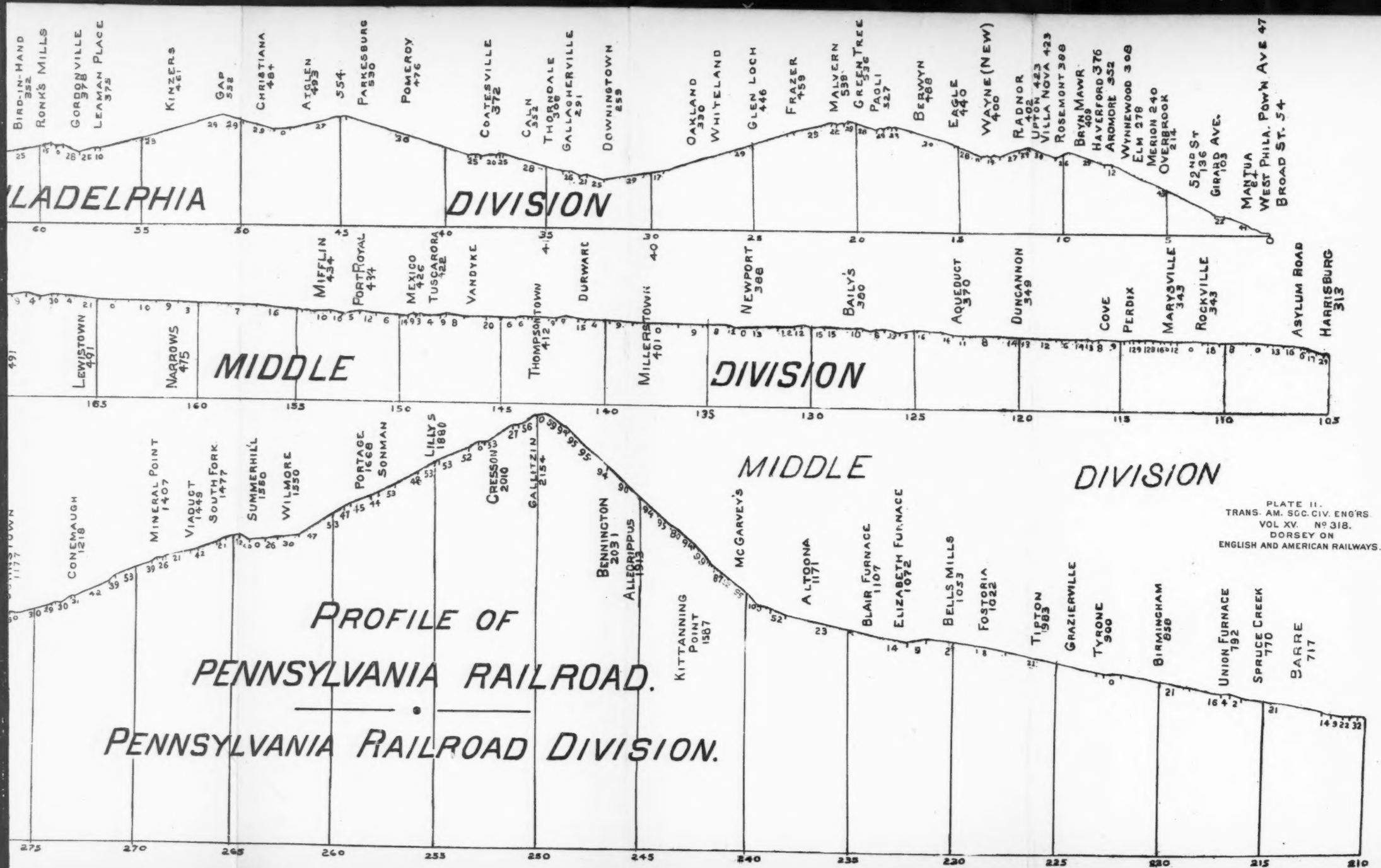
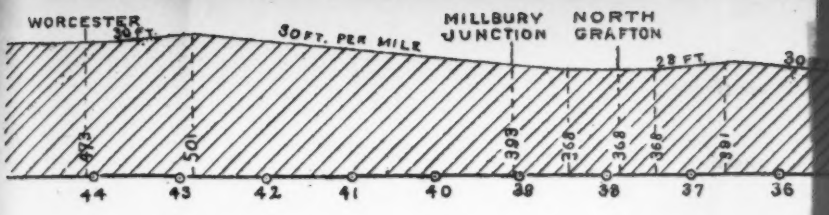
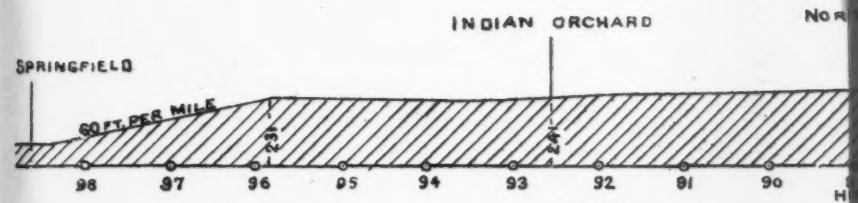
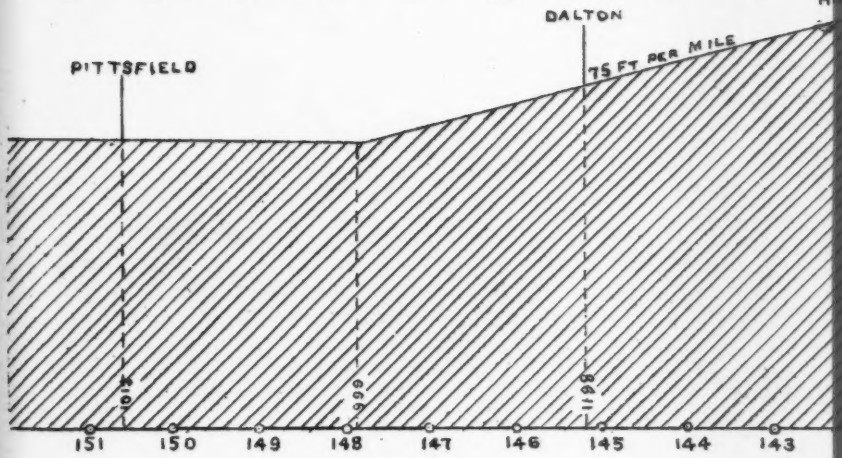
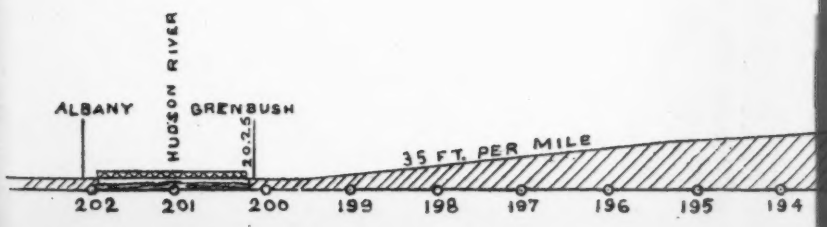
ALTOONA 1171

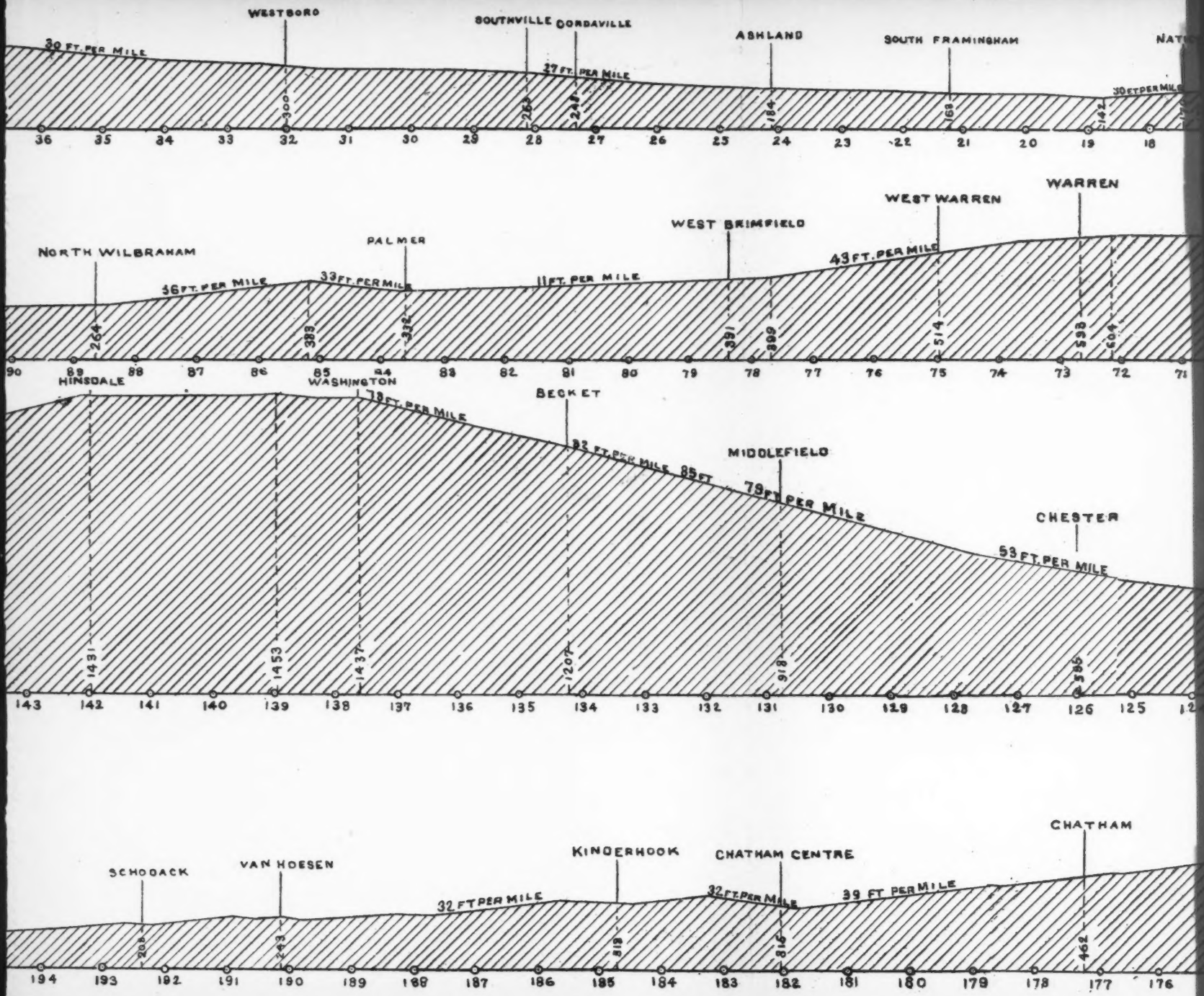

PHILADELPHIA DIVISION
MIDDLE DIVISION
MIDDLE DIVISION
PROFILE OF
PENNSYLVANIA RAILROAD.
PENNSYLVANIA RAILROAD DIVISION.
PLATE II.
TRANS. AM. SOC. CIV. ENG'RS.
VOL XV. Nº 318.
DORSEY ON
ENGLISH AND AMERICAN RAILWAYS.

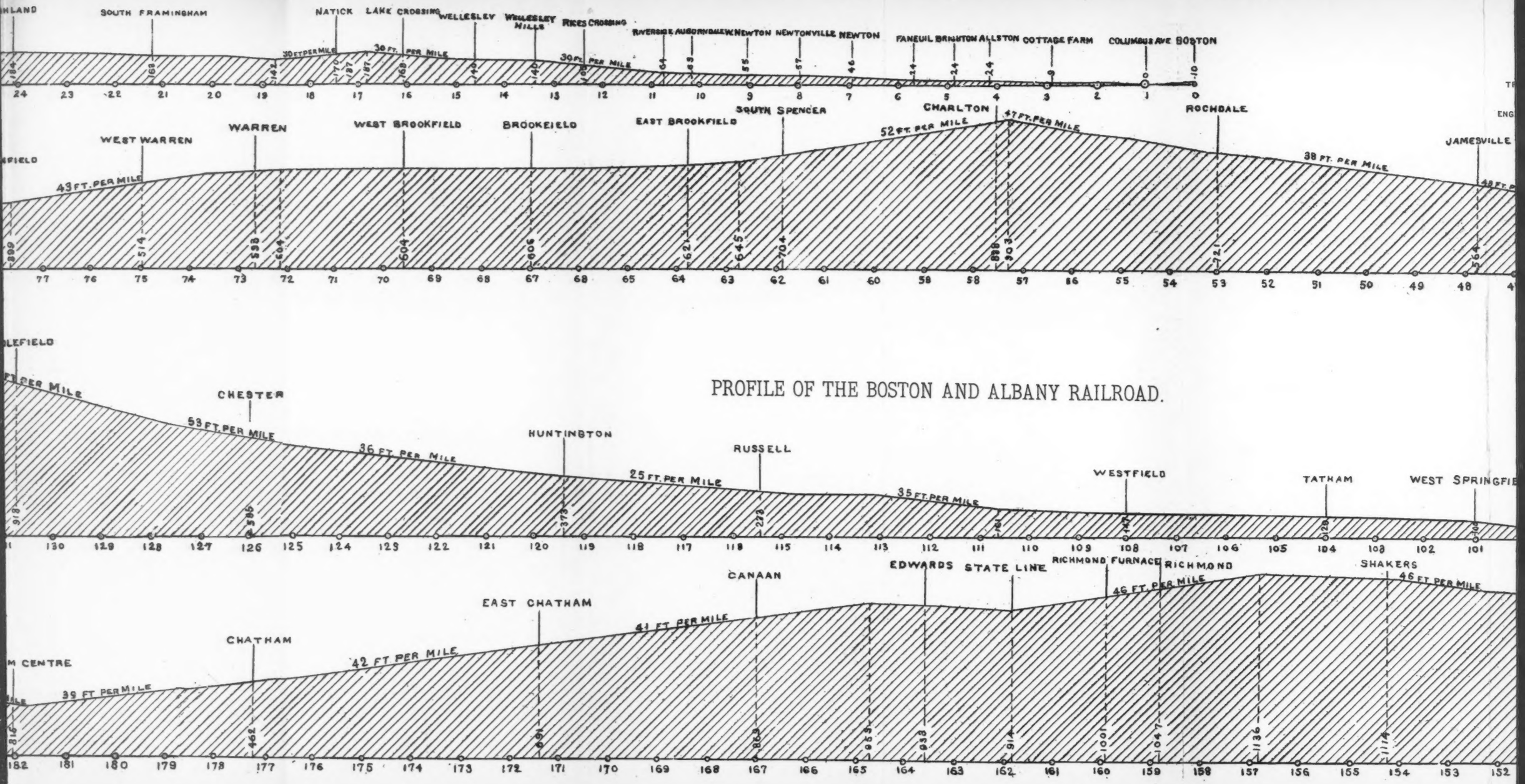

WORCESTER
30FT.
30FT. PER MILE
MILLBURY JUNCTION
NORTH GRAFTON
28 FT.
473
501
393
368
368
281
44
43
42
41
40
39
38
37
36


INDIAN ORCHARD
SPRINGFIELD
60FT. PER MILE
231
241
98
97
96
95
94
93
92
91
90


DALTON
PITTSFIELD
75 FT PER MILE
1013
999
1198
151
150
149
148
147
146
145
144
143


HUDSON RIVER
ALBANY
GRENBUSH
20.25
35 FT. PER MILE
202
201
200
199
198
197
196
195
194

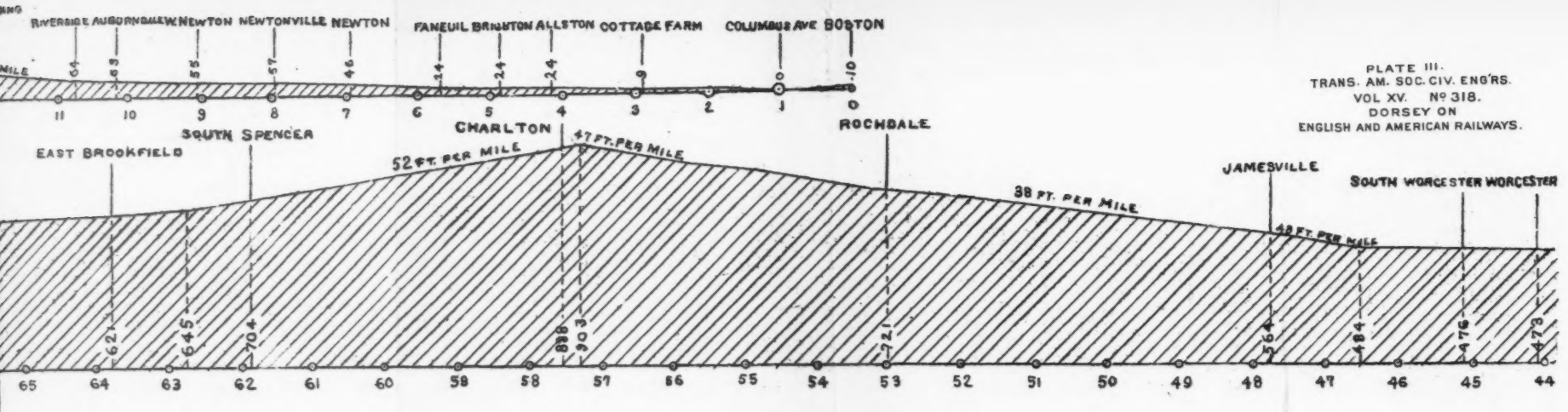

WESTBORO
SOUTHVILLE
CORDAVILLE
ASHLAND
SOUTH FRAMINGHAM
30 FT. PER MILE
27 FT. PER MILE
30 FT PER MILE
36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18
300
263
248
184
169
142
NORTH WILBRAHAM
PALMER
WEST BRIMFIELD
WEST WARREN
WARREN
36 FT. PER MILE
33 FT. PER MILE
11 FT. PER MILE
43 FT. PER MILE
264
333
332
391
399
514
598
604
90 89 88 87 86 85 84 83 82 81 80 79 78 77 76 75 74 73 72 71
HINSDALE
WASHINGTON
BECKET
MIDDLEFIELD
CHESTER
79 FT. PER MILE
82 FT. PER MILE
85 FT.
79 FT. PER MILE
53 FT. PER MILE
1431
1453
1437
1207
918
595
143 142 141 140 139 138 137 136 135 134 133 132 131 130 129 128 127 126 125
SCHODACK
VAN HOESEN
KINDERHOOK
CHATHAM CENTRE
CHATHAM
32 FT PER MILE
32 FT PER MILE
39 FT. PER MILE
208
243
818
816
462
194 193 192 191 190 189 188 187 186 185 184 183 182 181 180 179 178 177 176

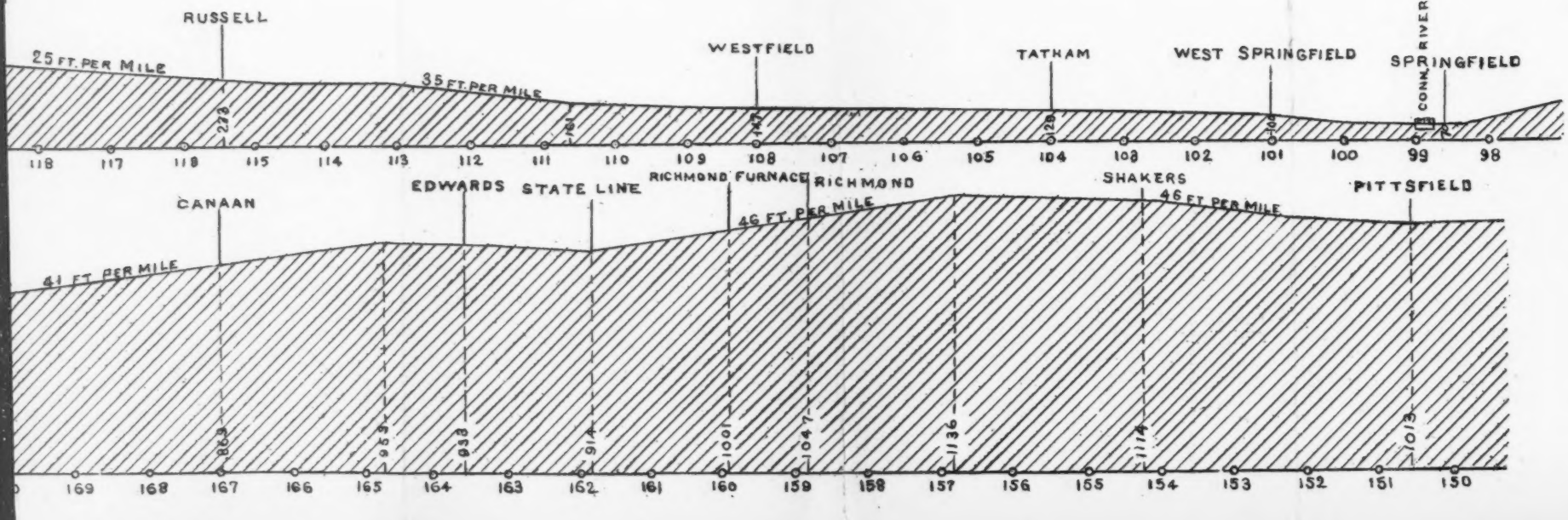


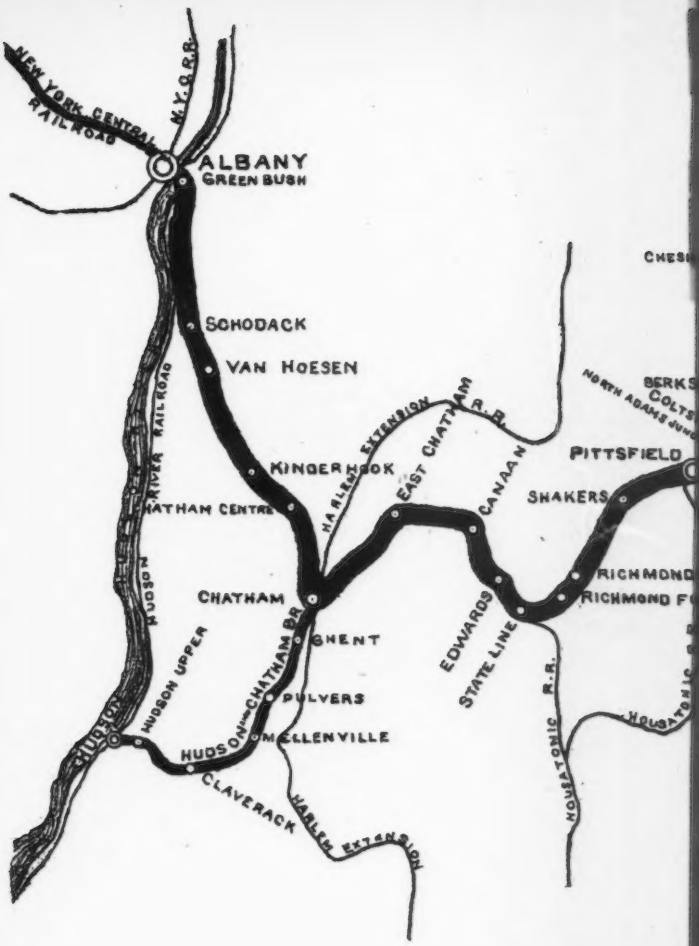
PROFILE OF THE BOSTON AND ALBANY RAILROAD.

PLATE III.
TRANS. AM. SOC. CIV. ENG'RS.
VOL XV. Nº 318.
DORSEY ON
ENGLISH AND AMERICAN RAILWAYS.

PROFILE OF THE BOSTON AND ALBANY RAILROAD.



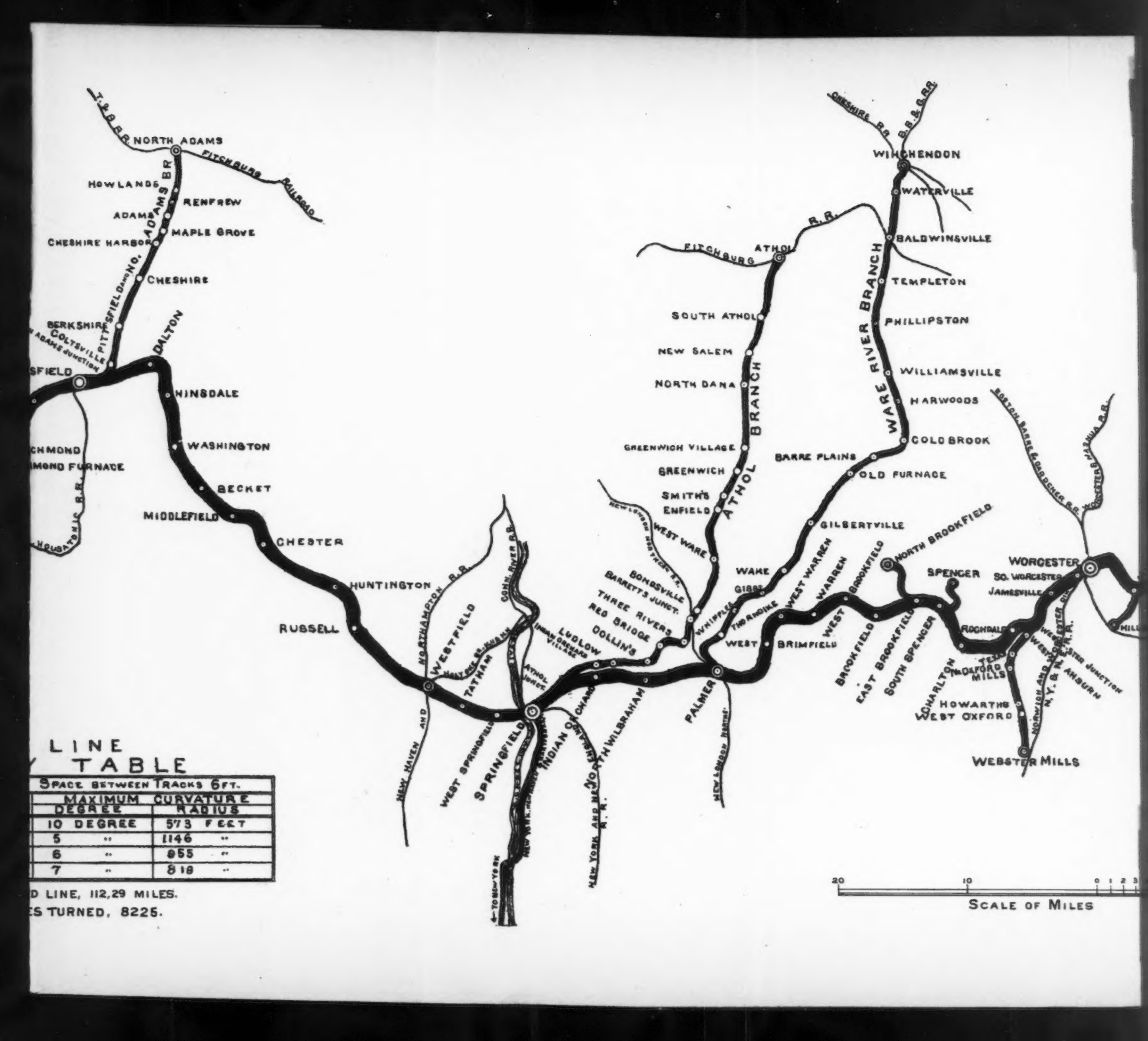




MAIN L
CAPACITY

GUAGE 4 FT 8½ INCHES		SPAC
DIVISION	CLEAR HEIGHT	M DE
No. 1	14 FT. 5 INCHES	10
No. 2	17 " 0 "	5
No 3	17 " 6 "	6
No. 4	16 " 3 "	7

TOTAL LENGTH OF CURVED LINE
TOTAL NUMBER DEGREES TUR



LINE
TABLE

SPACE BETWEEN TRACKS 6FT.	
MAXIMUM CURVATURE	
DEGREE	RADIUS
10 DEGREE	573 FEET
5 "	1146 "
6 "	955 "
7 "	818 "

D LINE, 112,29 MILES.
ES TURNED, 8225.

TABLE OF DIVISIONS

DIVISION No. 1			
MAIN LINE	BOSTON TO WORCESTER	44.10 MILES	DOUBLE TRACK
GRAND JUNCTION BRANCH	COTTAGE FARM TO EAST BOSTON	3.10 "	" "
NEWTON HIGHLANDS BRANCH	BROOKLINE JUNCTION TO COOK STREET	6.85 "	" "
NEWTON LOWER FALLS BRANCH	RIVERSIDE TO NEWTON LOWER FALLS	1.22 "	SINGLE TRACK
SAXONVILLE BRANCH	NATICK TO SAXONVILLE	3.70 "	" "
MILFORD BRANCH	SOUTH FRAMINGHAM TO MILFORD	2.00 "	" "
MILLBURY BRANCH	MILLBURY JUNCTION TO MILLBURY	3.00 "	" "
DIVISION No. 2			
MAIN LINE	WORCESTER TO SPRINGFIELD	54.53 MILES	DOUBLE TRACK
WEBSTER BRANCH	WEBSTER JUNCTION TO WEBSTER MILLS	10.11 "	SINGLE TRACK
SPENCER BRANCH	SOUTH SPENCER TO SPENCER	2.18 "	" "
NORTH BROOKFIELD BRANCH	EAST BROOKFIELD TO NORTH BROOKFIELD	4.16 "	" "
WARE RIVER BRANCH	PALMER TO WINCHENDON	49.20 "	" "
ATHOL BRANCH	ATHOL JUNCTION TO ATHOL	45.26 "	" "
DIVISION No. 3			
MAIN LINE	SPRINGFIELD TO PITTSFIELD	51.93 MILES	DOUBLE TRACK
NORTH ADAMS BRANCH	NORTH ADAMS JUNCTION TO NO. ADAMS	18.00 "	SINGLE TRACK
DIVISION No. 4			
MAIN LINE	PITTSFIELD TO ALBANY	51.54 MILES	DOUBLE TRACK
HUDSON BRANCH	CHATHAM TO HUDSON	17.17 "	SINGLE TRACK

PLATE IV.
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SUMMARY

DIV.	DOUBLE TRACK	SINGLE TRACK	TOTAL
No.1	60.05 MILES	19.99 MILES	78.04 MILES
No.2	54.53 "	110.91 "	165.44 "
No.3	51.93 "	18.00 "	69.93 "
No.4	51.54 "	17.17 "	68.71 "
TOTAL	218.05 "	166.07 "	383.12 "

SPRINGFIELD, 1885

SHEET No 1045

ROAD DEPARTMENT

BOSTON AND ALBANY R.R.

PROFILE SCALES
(SEE PLATE III.)
HORIZONTAL, ½ INCH - 1 MILE
VERTICAL, 1 INCH - 600 FT.

W.H. RUSSELL CHF. ENGINEER.
G.B. Hardy ASSIST. "
C.E. Alger DIV. ENGINEER.